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THE SCOPE AND RELATIONS OF TAXONOMIC BOTANY[1]

IN his famous work, "Philosophia Botanica," Linnæus, in accord with his fondness for system in all things, classifies the authors that have dealt with botany and allied subjects. He first divides botanical writers into two groups, true botanists, and botanophils or lovers of botany. The botanists are again divided and subdivided with much detail into numerous groups. The botanophils consist of four groups, the anatomists, the gardeners, the writers upon medicine, and lastly a miscellaneous group including those who write upon plants from the standpoint of economics, panegyrics, theology or poetry. It is clear from this classification that among those who concerned themselves with plants the systematic botanists held the dominating position. They were the real botanists, the others were only botanophils. Among the latter were the few anatomists and physiologists such as Malpighi, Grew and Hales. It is true that Linnæus has, as a subdivision under the true botanists, the heading physiologists, but he defines these as those who reveal the laws of vegetable growth and the mystery of sex in plants. This disposition of the physiologists was no doubt influenced by Linnæus's own interest in sexuality in plants. In this connection it should be noted that the great classifier places Hales, the physiologist, among the botanophils and not among the botanists. For a century more the botanical

[1] Address of the retiring president of the Botanical Society of America, Columbus, December 29, 1915.

field was dominated by the taxonomist. But at this time taxonomy meant for the most part only the study of the species of the flowering plants. During the nineteenth century other branches of botanical science asserted themselves and began to compete with taxonomy for supremacy. Toward the end of the century taxonomy not only lost its dominance, but in this country at least was relegated to an inferior place. At present the pendulum indicating the trend of botanical thought has swung far away from the position occupied during the days of Linnæus, Hooker, Torrey and Gray. Taxonomic botany in the conventional sense is almost taboo. There is a feeling abroad among botanists that systematic botany is old-fashioned and that to be a taxonomist is to be behind the times. At most of our institutions of learning taxonomic botany as such is not taught at all or is relegated to a minor position. At the meetings of our botanical societies the percentage of papers dealing with taxonomy is disproportionately low. In a recent number of the *Plant World* it was stated that out of the 45 doctorates in botany conferred by American universities in 1915, two were taxonomic. The same disproportion prevails in most of our journals and periodicals devoted to the whole field of botanical science. It is difficult also to obtain properly trained young men for positions in taxonomic botany.

Let us examine the causes that underlie these conditions, first, the dominating position of systematic botany during the eighteenth and early part of the nineteenth centuries, and second, the gradual loss of prestige since the middle of the last century and the inferior position in botanical thought now occupied by systematic botany as represented by the classification of species.

The botany of the seventeenth century consisted almost entirely of the enumeration of the known species of plants. Up to this time, the chief interest in plants, leaving out of consideration of course the crop plants, had been their use in medicine. From the practical standpoint it became necessary to record the known species and to describe their uses. These records are preserved in those massive tomes generally classed as herbals.

As the number of known species increased, attempts at classification were made, crude at first but reaching an advanced stage in the eminently practical sexual system introduced by Linnæus. There was early a reaching out for a natural system of classification. Even Linnæus, the creator of the sexual system, tells us in his famous text-book, cited above, that a natural classification is diligently to be sought, that plants show affinities on all sides like a territory in a geographical map.[2] He then proposes 63 groups of flowering plants and four others to include the ferns, mosses, algæ and fungi. The first work to use a natural system on a large scale was Decandolle's "Systema,"[3] the first volume of which was issued in 1818. The natural system soon displaced the Linnæan system.

The years from 1790 to 1850 were an era of botanical exploration. Thousands of plants from all quarters of the globe poured into the centers of botanical research. There was much work for every botanist who was capable of distinguishing and describing species. Every collection received

[2] *Phil. Bot.*, 27, 1751. "Methodi naturalis fragmenta studiose inquirenda sunt. Primum et ultimum hoc in botanicis desideratum est. Natura non facit saltus. Plantæ omnes utrinque affinitatem monstrant, uti territorium in mappa geographica. Fragmenta, quæ ego proposui, hæc sunt."

[3] Decandolle, A. P., "Regni vegetabilis systema naturale," 1, 1818; 2, 1821.

from exploring expeditions yielded scores or even hundreds of new species. Is it to be wondered at that taxonomy held a dominating position in botanical research and that most of the great botanists of the period were taxonomists? At the beginning of this period modern chemistry and physics were in their infancy and the compound microscope had not yet been perfected. It is easy to see why it was that well along into the nineteenth century botany was considered to be chiefly the description and classification of species. Furthermore, botanists were working upon the hypothesis of created species, not upon that of the evolution of species.

Let us turn back for a moment to note the growth of experimental science. Of science as we understand it there was little in the middle ages. Instead was authority. Arguments were settled, not by direct test, but by consulting the statements of the Fathers. Tradition hampered the development of all branches of human research, especially of the sciences. The statements of Aristotle were for ages considered infallible. That the root of the mandrake cried with pain when torn from the earth and that the fruit of the goose tree developed into bird or fish according as it fell upon the land or in the water, was accepted without question. Here and there a courageous soul by questioning tradition created much disturbance and brought upon himself the revilings or at least the reproaches of the powerful. Slowly at first, more rapidly during the latter part of the eighteenth century, grew the tendency to test theories by experiment, to verify facts. Great minds were attracted to the field of scientific research. There was a certainty about the relation between cause and effect that was vastly satisfying to the intellectually alert. The discovery of oxygen by Priestly in 1774 gave an impetus to chemistry. Upon the foundation of facts accumulated up to about the time that Davy decomposed potash in 1808, Dalton was able to present a theory of the construction of matter, the atomic theory, which to a remarkable degree has answered up to the present time the requirements of a working hypothesis even though modified by recent discoveries. Faraday, the great experimenter, somewhat later laid the foundation for the extraordinary development in the domain of electro-magnetics. The microscope was greatly improved, opening up a wide field of research concerning the internal structure of plants. During the nineteenth century there was much interest in plant anatomy, in the development of the cryptogams, and finally in plant physiology. A growing proportion of botanists devoted their attention to these or allied branches. The theory of the special creation of species was superseded by that of the evolution of species. As the experimental method was widened in its application to the various fields of botanical research, the science of botany became increasingly attractive to intellectual workers. But in this increased interest and activity descriptive taxonomy has not retained its share. At the beginning of the nineteenth century nine tenths of the prominent botanists were engaged in the discrimination of species. At the beginning of the twentieth century probably not one tenth are thus engaged. This reversal of proportion is due in part to the widening field of botany. Still I think that there is at present in descriptive taxonomy an evident lack of interest that is not entirely explained by this widening of the field of botanical research.

What are the reasons for this lack of interest in what is conventionally known as systematic botany? Some botanists, especially of the younger generation, have be-

littled descriptive taxonomy because this seemed the popular thing to do, having received the impression that taxonomy was old-fashioned. Some, also of the younger generation, have come little in contact with the subject during their period of training, hence consider it a very special line which is rather a side issue compared with such subjects as morphology and physiology. Some have felt that a career in systematic botany offered little in the way of reputation or of financial return, and so have entered more promising fields.

Another reason for the somewhat suspicious attitude assumed by some botanists toward taxonomy is the prominent part assigned during the last twenty-five years to nomenclature. The creditable desire to place nomenclature upon a sound basis has resulted in many changes in familiar names. Such changes have been embarrassing to morphologists and physiologists who look with disfavor on changes in terminology except in their own branches. Furthermore there have been auxiliaries who have taken advantage of the unsettled condition of nomenclature to substitute the study of names for the study of plants.

These reasons, however, are inconseqential. They would deter no one imbued with the scientific spirit. Is not the fact that there has been no satisfactory way of applying the experimental method to the discrimination of species the real reason why descriptive taxonomy has been avoided by so many botanists? In chemistry and physics the relation between cause and effect can be tested and results can be foretold. In recent years the same method, answering questions by direct test, has been applied in many branches of botany. But in taxonomy one has no definite test by which results can be proved. One may put in years of hard work and seem to get nowhere. You will remember how Charles Darwin struggled with the classification of barnacles and Asa Gray with asters. I thoroughly sympathize with them, as will every botanist who has attempted a serious study of the classification of a difficult group of plants. We work over them for months, patiently noting differences and resemblances, assembling and segregating, seeming to have a scheme nicely worked out, only to have it upset by a new batch of specimens, going through all the stages of hopefulness, satisfaction, doubt, hopelessness, and finally tearing our hair and exclaiming "Confound the things! What's the matter with them, anyway?" This kind of work does not appeal to the average scientist. He prefers to wrench facts from nature by frontal attack, by applying the experimental method. He wants to do something under controlled conditions and see the result, having the assurance that under the same conditions he will always have the same result. To him this puttering over the differences of species is the veriest waste of time—that is, of his time. His attitude towards the classification of species is much like the attitude of descriptive taxonomists towards the classification of horticultural varieties. If the horticulturist classifies the hundreds of varieties of the apple by such characters as color, form, size, markings and time of ripening, the groups will merge into one another. The resulting classification can be used only by those who know the varieties; but if they know the varieties they do not need a classification by which to identify them. This is somewhat exaggerated, but it fairly well represents the way the classifier of species looks at the work of the classifier of horticultural varieties. And I think it represents the way the physiologist looks at the work of the taxonomist. This is not said in disparagement of the work of classifying horticultural varieties. It is given

only as an example of how such work suffers by being far removed from the field of experimental research.

The taxonomist arrives at results not by the application of the experimental method, but by the repetition of observations. To be sure the geneticists are applying the experimental method with considerable success, but their results can have no immediate bearing on the subject under discussion. Ascertaining facts by the method of repeated observations lacks the precision and definiteness of the experimental method. The examination of hundreds of herbarium specimens, plant mummies, is not so fascinating nor so satisfying as it is to set up a piece of apparatus and see something happen. I believe this is the chief reason why so many of our keenest minds have hesitated to join the ranks of the descriptive taxonomists, the results appearing to them indefinite in proportion to the time and energy spent in obtaining them.

Now let me review with you the scope of taxonomy in the broad sense, the science of classification. To me the two great questions that botanists seek to answer are, *how do plants live?* and *how are plants related?* Most botanical investigations can be used as an aid in answering one or the other of these questions. From this standpoint the two fundamental divisions of botany are physiology and taxonomy. Many facts in physiology may be established by experiment. Most facts in taxonomy are established by repeated observation. Various subsidiary branches of botany may aid one or the other of these fundamental divisions according as the facts obtained are used in answering the main question. Morphological studies gather certain facts which in themselves are interesting, but which reach their highest usefulness only when structural morphology yields to physiology and comparative morphology yields to taxonomy.

Taxonomy in the general sense is the science of classification. But the taxonomy with which we are concerned is that which attempts to answer the question, how are plants related. The very question implies that plants are related. Our taxonomy assumes the evolutionary hypothesis that all the organisms of the present day have developed or evolved from other somewhat different organisms of the past. The great truth which taxonomy is seeking to express is the genetic relation of organisms. If the genetic history of all organisms were known the classification of these organisms would be merely an arrangement of facts. But the genetic history of organisms is not known, or known only for an infinitesimal number for an infinitesimally short period of time. Our classification of plants is, then, an expression of judgment as to what are the probable genetic relations of these organisms. At the best this classification can represent only a cross section of the lines of phylogenetic development. It may be compared to a formula in calculus with a large number of variables. The value of the formula may be found for any given moment by substituting the values that the individual variables have at that same moment.

Some workers in this broad field of systematic botany are studying the relations of the more comprehensive subdivisions of plants such as the families, orders and groups higher than these. In such investigations they seek for resemblances, as it is these upon which, rather than upon differences, the interpretations of relationship must be based. Some botanists, on the other hand, are concerned chiefly with the determination of the relations of the ultimate systematic groups of organisms, the species and their subdivisions. Here the observer

is seeking differences, for the resemblances are plain to be seen.

Intermediate between the species and the family lie groups, such as the genus and the tribe, in which one must look for both differences and resemblances and strike a balance between them. The botanist who studies species, and hence looks for differences, compares the more superficial characters of plants, those that are most easily modified in the development of new forms. The botanist who studies the relation of orders and more comprehensive groups, is concerned chiefly with those characters which have resisted modification in the course of development. I have referred to the work of the former as descriptive taxonomy. The work of the latter is often included in the designation comparative morphology. It is to be regretted that there has been some lack of understanding between these two groups and a consequent lack of sympathy. A title such as "The Morphology of *Cycas* and *Welwitschia* and its Bearing on the Origin of the Gymnosperms" would attract one group as being an important paper in comparative morphology, while a title such as "Five Hundred New Species of *Rubus*" would be laid aside with the remark, "another species-maker broken loose." The one looks upon the other as a species-maker who knows little of the real problems of botany. The other looks upon the one as a section-cutter who knows plants only through the compound microscope. Both may be doing really good taxonomic work. This is determined, however, not by the fact that one is cutting sections and the other is describing species, but by the fact that each is using scientific methods and is dominated by the scientific spirit.

The ideal of the taxonomist is a scheme which shall represent the genetic relations of organisms. Each of us who are taxonomists is hoping to contribute his mite toward this harmonious whole. The lines of descent are real though unseen; they exist, but their position and direction can not be proved. As the astronomer studies the constitution and evolution of the universe, as the chemist studies the constitution and evolution of matter, so the taxonomist studies the constitution and evolution of organisms. One of us may be describing new species of *Rubus,* and showing their relation to previously known species. Another may be revising a genus of mosses and adjusting the relations of the species in the light of recently acquired knowledge. Another may be studying the comparative anatomy of seaweeds and with the observed facts attempting to solve the problem of relationship. Another may be studying the development of the spores of smuts and tracing, as it were, the prehistoric development of the group. Thus are anatomy, morphology, ontogeny, paleontology, yielding facts to taxonomy. Thus are we all uniting in the great effort to answer the fundamental question, how are plants related.

Considering the trend of botanical thought during the present decade, I need not ask the members of this society if comparative morphology is an interesting field of research. My predecessor and my successor are shining examples of those who have advanced the limits of our knowledge in this branch. But the domain of descriptive taxonomy, the elaboration of genera and species, is this an inviting field for the young botanist who is seeking an opportunity to take part in solving the problem of relationships?

For reasons already given this branch has been unpopular in recent years. Though descriptive taxonomy will never attract workers to the proportionate extent that it did before the rise of the experimental sciences, yet it will be found to satisfy the

cravings that are characteristic of the students of science. The mental satisfaction of the scientist who loves his work comes not alone from achievement, but from the actual doing.

There is the search for truth, the discovery of facts, the arrangement of the facts to represent relationships, the peering behind nature as she is to determine how she came to be what she is, the blending of all into a harmonious whole, the feeling that we are solving one of the fundamental problems of the universe. Our imagination bids us soar aloft in the realms of speculation, but our progress in these delightful journeys is ever limited by the chains of facts binding us to earth. We are victims of the inexorable law of compensation. We must pay the price for successful flights in this realm of speculation where we dream our dreams and build our theories. This price is the drudgery of slowly accumulating facts. We must work, work, work. We must examine thousands of specimens, both living and preserved, in herbarium, garden and field, just as the comparative morphologist must examine thousands of sections, staining, cutting, mounting. We must measure and weigh evidence, persistently, patiently, accurately. It is thus that we lengthen the chains binding us to earth and thereby soar higher and higher. Occasionally one of us is so exhilarated with the joy of soaring that he severs the chains of facts and rises unrestricted, but, alas, soon disappears from view. Some of us are so busy with our facts that we never have time for soaring. Only a few have that happy combination of industry and imagination that allows them to rise to great heights and yet remain within our view. These few have that rare ability to select related facts, to distinguish the essential from the non-essential, to separate the significant from the insignificant.

The laboratory of the descriptive taxonomist is three fold, the field, the herbarium and the garden. The facts concerning the plants that he studies can most satisfactorily be observed from living specimens in their native habitat, that is in the field. Apart from the practical impossibility of observing in the field all the plants that the worker may wish to study, there is the difficulty of comparing those that grow in different localities. This difficulty is in part overcome by bringing together in a herbarium preserved specimens. The disadvantage of studying herbarium specimens is that in the larger individuals only a part can be represented and that many characteristics of the living plant can not be shown. By far the most satisfactory method of studying plants from widely separated localities is to bring them together in a botanic garden where they may be preserved alive. It is almost hopeless to attempt the study from herbarium specimens alone of such groups as cactuses, palms, agaves, and bamboos. I can not let this occasion pass without emphasizing to you the importance to taxonomy of having a national botanic garden. Under the supervision of the federal government such a garden is likely to receive more ample support than one depending upon state, municipal, or private aid, and because of its national character is likely to extend its influence over a wider area.

There is another phase of descriptive taxonomy—an eminently practical one—which merits attention, namely, certain relations between this branch and all other branches of botany, relations which involve the use of the botanical names of plants. Taxonomy is the classification of organisms, but definite progress requires the use of names for the organisms classified. Names are older than systems of classifica-

tion. First there were vernacular names in the different languages. Then vernacular names in Latin acquired prominence because Latin early became the language of the books. Later we have the development of the idea of the genus with the corresponding application of the generic name, the kinds or species being distinguished by descriptive phrases. And finally Linnæus introduced the use of the trivial or, as it is now called, the specific name. Thus each species is designated by a binomial. You will readily see that plant names become, as it were, units of precision by which all branches of botany are standardized. From this standpoint taxonomy is fundamental because it furnishes the standard units of comparison and coordination, these units being not merely the names but the ideas which these names represent.

Botanists not always have been sufficiently impressed with the necessity of basing results upon carefully prepared standards. If a chemist wishes to determine acidity by titration he first prepares standard solutions of acid and alkali; or if he wishes to determine the atomic weight of zinc he first prepares pure zinc or zinc salt as a basis from which to work. If a surveyor wishes to cover a country by triangulation he first measures with extreme accuracy his base line. Results can not be compared unless they are based upon an accurate common standard. Suppose a chemist wishes to determine the solubility in water of sodium carbonate at different temperatures and to compare his results with those obtained by a chemist in another country. Suppose he is well trained, accurate in his methods, has balances weighing to a small fraction of a milligram, determines the solubility of his glass vessels, and the purity of his distilled water, and is able to calculate results within small limits of probable error. Then finally suppose that he bases all his careful work on a bag of washing soda obtained at a corner grocery. What would you think of him? Suppose an American botanist wishes to repeat the investigations made by an English botanist upon the anatomy of the stem of the day lily. Suppose that he is well trained, accurate in his methods, has the finest of microtomes, has at his command the last word on staining and methods of imbedding, supports his record with magnificent photomicrographs, and is a master of all the technique required. Suppose he is not acquainted with the day lily, but nevertheless trusts his untrained gardener to bring for his investigation a plant which the latter thinks probably is a day lily. What would you think of him? I have attempted to illustrate my point by exaggerated examples. I wish, however, to emphasize the statement that all comparative investigations upon plants depend for their usefulness upon accuracy in the identification of the species compared. Even competent and experienced botanists have sometimes neglected to establish at the beginning of an investigation this firm basis for work. The less experienced man is sometimes inclined to assume, especially if he has had limited training in taxonomy, that plants in gardens, greenhouses and herbaria belong to the species indicated by the labels they bear. Such faith is beautiful to behold, but, alas and alack! the worker is often a victim of misplaced confidence. The investigator should first establish the identity of the plant which he studies. If he has not had sufficient training in systematic botany to enable him to do this himself he should refer his specimen to a competent taxonomist and preferably to a specialist in the group to which the plant belongs. In comparing results based upon definite species of plants there arises

another uncertainty. Supposing that the second of two investigators whose results are to be compared, has based his work on correctly identified material, can it be assumed that the first investigator has taken equal pains to identify his material? Unfortunately this assumption may be without sufficient foundation. One must consider the probability of error. The paper recording results may show internal evidence of a satisfactory nature. The author may state the origin of his material or note the care taken in its identification, or that it was submitted to a specialist. Any such internal evidence increases confidence in the results. If the plants used by both investigators of this hypothetical pair have been accurately identified we may apply the mathematical axiom, things equal to the same thing are equal to each other. However, the probability of error is very greatly reduced if direct comparison can be made. This can be done only if each investigator has preserved the plants he has studied. This leads me to make this plea to botanists. Let every worker preserve the specimen he has studied if his results are in any way connected with the identity of the species. I think that anatomists, cytologists, morphologists, and others that study the internal structure of plants, are in the habit of preserving in alcohol or other liquid, the portion of the plant with which they have worked. Specimens of this kind should always be preserved in order that observations may be confirmed, but fragments, such as these are likely to be, are not usually sufficient for taxonomic identification. For the latter purpose a specimen should be prepared and placed in a public herbarium, accompanied by a label bearing the data necessary to connect the specimen with the investigation that it supports. If such supporting evidence is at hand any controversy as to the identity of the plants studied by different workers can be settled by consulting these herbarium specimens. The physiologist may find it to his advantage to follow the same procedure. His work is often with plant life in general rather than with particular species. But whenever his investigations concern definite species he should preserve herbarium specimens. The ecologists are fond of giving lists of plants growing under certain conditions and comparing these plants with those growing under similar conditions elsewhere. In the early days of this younger branch of botanical science little attention was paid to the identity of the species, and still less to preserving representative specimens. The subject was lightly waved aside with the assertion that they were not concerned with the identity of the individual species, only with the aspect of the vegetation. The modern school of ecologists, I am pleased to say, takes a more serious view of the rôle played by definite species. If it is worth while publishing a list of species at all, it is worth while supporting the record with permanent evidence. The geneticists, a young and active brood of investigators, will find it to their advantage also to adopt the method outlined above. The living specimens are the best of evidence while they exist, but at best they are evanescent. Herbarium specimens, if properly prepared and properly cared for afterwards, are permanent. If his plants have been passed upon by a general taxonomist or better by a group specialist the non-taxonomist may be deluded with the idea that his record is complete, that the identity of his species is beyond question and is fixed for ever and ever. Such an assumption depends upon the infallibility of taxonomists. I can assure you, however, that taxonomists are very fallible. Specialists may not agree among themselves on the identity of a

given plant, and the same specialist may not agree with himself on the identification of the same plant made at different times. This is not said to discredit the specialist. But specialists in taxonomy like specialists in other lines are not, even though specialists, masters of all the knowledge of the group of plants they study. Their opinions may change as their knowledge increases. Then let me repeat, the only safe way to support records when definite species are concerned is to preserve specimens and place them in a public herbarium.

The names of plants are the common language connecting all sciences and arts having any relation to botany. For a large part of the botanical public, consisting of agriculturists, horticulturists and many botanists, especially those who are not taxonomists, the usefulness of taxonomic work lies in the ease and certainty with which botanical names can be applied. To them names are convenient symbols by which plants are known. A change in the application of botanical names is as confusing as the change of a person's name. Consequently they look with concern and disfavor upon the seemingly kaleidoscopic changes undergone by the names of common plants. After the publication of the "Rochester Code" there was a rush to bring plant names in accord with this code. Some of this work was serious or at least sincere. Some was such as to leave the impression that the authors had in mind chiefly the publication of new combinations. The flood of new names appearing in lists, local floras and isolated notes, the work based upon a study of books rather than of plants, produced an unfavorable effect upon the standing of systematic botany. Those unfamiliar with the real scope and meaning of taxonomy hastily concluded that this branch of botany was for triflers, was not worthy of serious study, and was to be avoided.

But we should not be confused by superficialities. For example, an enthusiastic youth, wishing to climb the ladder of fame, makes a voluminous list of plants growing in swamp, in prairie and in forest, and inflicts upon the public, "The Ecology of Podunk." His brother, with an equally laudable purpose, delves in some musty volumes, consults the Index Kewensis, and emerges with a list of brand-new combinations, after each of which appears his own name as the authority. Let us not judge the scope of ecology by the incomplete efforts of the one, nor the scope of descriptive taxonomy by the misdirected efforts of the other.

Nomenclature is an essential detail in all taxonomic work. One should not hesitate to change a name if there is a necessity for a change. It has been said that a name is an expression of a taxonomic idea. Nothing should stand in the way of the most precise expression of correct taxonomic ideas. While it is desirable to conserve familiar names it is a poor policy to avoid change merely to conserve names. The objection, then, is not to the study of nomenclature as a detail in connection with monographic work, but to its study apart from the study of the organisms to which the nomenclature applies. There is even objection to work in which a superficial consideration of organisms is merely a series of pegs upon which to hang an elaborate study of nomenclature. Changes in names should be evidently a result of serious study of the group concerned.

The non-taxonomic public is constantly pleading with the taxonomists "to get together," to agree on a system of nomenclature which shall result in the stability of plant names. The taxonomists, I may say, are sometimes impelled to voice the same

sentiments in so far as concerns changes of names in groups of plants of which they have no special knowledge. Several attempts have been made to legislate upon the subject of nomenclature. It has been impossible thus far to frame a set of rules to which all botanists can agree. There are the rules of botanical nomenclature formulated at the International Botanical Congress held at Vienna in 1905. These rules are often referred to as the Vienna Code. To many competent botanists in both Europe and America these rules are so unsatisfactory that they will not subscribe to them. In this country many botanists have agreed upon a code, usually known as the American Code, which from the practical standpoint is more certain in its application. These two codes provide that our nomenclature shall begin with the year 1753, the date of the publication of the first edition of the "Species Plantarum" by Linnæus. There are still other botanists who would throw aside all limitations to the rule of priority and use the earliest names to be found in literature. Recently some one proposed a new name for the genus *Zizania* because *Zizania* of Linnæus, the swamp grass called wild rice, is not the same as *Zizanion* of the New Testament, which is the name of the weed the enemy came and sowed and which in our version is called "tares." It is not my purpose here to discuss these systems of nomenclature. I am only calling attention to the lack of unanimity on the subject among taxonomists. But suppose all taxonomists should agree upon a single system of nomenclature. Would this do away with the changes of names? By no means. In the first place it would take years to adapt the hundreds of thousands of names of plants to any code that might be adopted. But aside from these changes coincident with the search through countless books, pamphlets and ephemeral sheets, some very rare, some probably unknown to the present generation of botanists, aside from these changes due to the imperfections of our records, there are other changes resulting from the increase in our knowledge of plants. Stability in nomenclature is unattainable, just as stability or permanence in any branch of learning is unattainable so long as our knowledge concerning that branch is increasing. Codes of nomenclature enable botanists to make changes according to definite rules, they do not eliminate change. We shall have stability of nomenclature only when we have stability of taxonomic ideas, which latter will come only with infinite knowledge.

This society includes a large percentage of the botanists of this country, physiologists, morphologists, taxonomists, paleontologists, ecologists, cytologists, anatomists, geneticists, pathologists, but all botanists, and all contributing to the upbuilding of the science of botany. The society might be compared to a living organism, in which each botanist is performing a definite work contributing to the success of the society, even as each organ, or each cell, performs a definite function necessary or helpful to the life of the organism. By far the greater part of our work consists in accumulating details. As a successful army can not consist solely of generals, so a successful botanical society can not consist solely of philosophers. As the great general is one with an extended knowledge of the duties of his subordinates, so the true philosophical botanist must be intimately acquainted with much of the detail of the worker, the drudgery of small things.

When first we enter the realm of botanical research we long in the impatience of youth to make some great discovery, to reach at a single bound the heights to which others slowly toil. As we grow older we

realize that we must "build the ladder by which we rise." Each of us finds that he is but one of a vast army of patient plodders, seekers after truth. We become more and more willing to do that which is close at hand, to seize small opportunities as they pass, rather than waste time looking for the great opportunities of our dreams. Darwin was one of our great speculative philosophers, but his philosophy was founded upon an amazing array of facts, and his experience as an observer of details, especially that gained in his classic taxonomic investigation of the barnacles, contributed in no small degree to the soundness of his philosophical judgment.

Though the realm of botany, as a whole, is too great for any one individual to comprehend all its branches, and each must confine himself to one or two branches, the sympathy of each may and should extend to every branch. Finally, the ideal of taxonomy is the utilization of the results obtained by all the branches of botany; it is the expression of the sum of the knowledge to which all contribute; it is the philosophy of botany in that it correlates the parts into a harmonious and ever growing whole.

A. S. Hitchcock
U. S. Department of Agriculture

THE CENTIGRADE THERMOMETER

The Hon. Albert Johnson, member of Congress from the third district of the state of Washington, under date of January 12, addressed to members of the American Association for the Advancement of Science the letter which follows:

A reprint of my speech "Abolish the Fahrenheit Thermometer," dealing with Bill H. R. 528, introduced by me on December 6, 1915, is sent herewith to all members of the American Association for the Advancement of Science.

The speech is followed by extracts from letters, and I profit by this opportunity to express my sincere thanks to the writers of those letters for the valuable aid which they have rendered. I request that this acknowledgment be accepted in lieu of a personal reply, which I am reluctantly compelled to forego, owing to lack of time and clerical help.

The labor and expense involved in this undertaking will at best be considerable. Already the expense for printing exceeds $150. While every step should be taken with due deliberation, any unnecessary delay would involve a regrettable increase of labor and expense. If no action is taken at this session of congress, much of the work will have to be done over again at some other session. No man that has any regard for his reputation will care to say that the irrational, inconvenient Fahrenheit scale ought to be maintained; the only question is, how soon it should be abolished. An amendment lengthening the transition period to 8 or 10 or 15 years may be worth considering, but we should ill deserve our reputation as a progressive nation if we delayed to *set a date* for the abolition of a daily felt nuisance. As pointed out by several correspondents, it ought to have been done long ago. The change will necessarily be attended with considerable inconvenience, but this will not be lessened but increased by delay. We have already earned enough ridicule by clinging so long to the worst thermometric scale.

Every man in a responsible position now has a chance to gain credit by doing his best to facilitate the change. If any should feel tempted to advocate delay, they ought to consider that they would thereby gain not credit but discredit, because the change is sure to be made in the near future.

The Pan-American Scientific Congress has twice recommended "the establishment of the Pan-American Meteorological Service." Evidently the first requisite for that purpose is the abandonment of the Fahrenheit scale.

It appears that the government departments have authority, under existing law, to discontinue the use of the Fahrenheit scale. In publications designed for the scientific public, many bureaus do use the centigrade exclusively. However, as regards publications intended for the general public, it is evident that the departments would expose themselves to severe criticism if they made the change without an express mandate from congress. Congress evidently will not act except in response to an unmistakable demand on the part of the scientific public.

All progressive scientists, therefore, should unite to rid American science of this "iron shirt of

habit.'' By a resolute simultaneous effort at the first onset, when interest is fresh, we may avoid the necessity of spending ten times the amount of labor in wearisome and costly agitation. No earnest man should excuse himself on the plea that ''the others'' will push the bill through without his help. If every man took that attitude, there would be no ''others.''

At my request a committee, under the chairmanship of Dr. S. W. Stratton, Director of the Bureau of Standards, has been appointed by the American Association for the Advancement of Science to take charge of the bill. This committee, located at Washington, within easy reach of congress, will serve as the natural center of a nation-wide organization. All communications on the subject should hereafter be addressed to ''Thermometer Committee A. A. A. S., Bureau of Standards, Washington, D. C.''

It is recommended that local committees, as branches of a national organization, be formed in all the states, to bring the subject to the attention of the press and to secure the adoption of resolutions by scientific and educational organizations, faculties of universities, firms, corporations, etc. Copies of such resolutions—the briefer the better—should be sent to as many individual members of congress as possible.

The American Association for the Advancement of Science, with nearly 9,000 members, might itself be deemed fairly representative of the American scientific public. Nevertheless, in order to avoid the criticism that this measure was pushed through congress without adequate consultation of those concerned, I shall be glad to send this circular and the reprint of my speech to other societies, if their secretaries will express a wish to that effect. As the type is kept standing, it will be easy to order new editions as fast as the demand for them arises. By thus submitting the question, as nearly as possible, to a popular vote of all those who are competent to express an opinion, all semblance of arbitrary action may be avoided.

Meantime it is hoped that the present circular and accompanying speech will be reprinted and discussed as widely as possible in the scientific and popular press, so that any one who cares to raise objections may have a chance to do so. Clippings containing such printed discussions will be thankfully received by the above-named committee.

For the present you can render valuable aid by answering the questions on the enclosed question sheet and mailing it in the enclosed envelope, which requires no postage. Unless you express a wish to the contrary, it will be assumed that you permit the publication of your remarks entire or in extract.

The questions are as follows:

1. Should the use of the Fahrenheit scale be discontinued?
2. Can you suggest arguments in addition to those contained in the accompanying documents?
3. Can you suggest amendments to the bill? (Text of bill on page 3 of speech.)
4. What length of time should be allowed before the use of centigrade degrees, with or without the addition of the equivalent in Fahrenheit degrees, becomes obligatory in government publications?
5. What length of time should be allowed before the use of Fahrenheit degrees in parentheses after centigrade degrees is discontinued?
6. In case you were invited by the Committee on Coinage, Weights and Measures to state your opinion orally before them, would you be willing to come to Washington for that purpose?
7. Do you know of any organization that might be willing, on invitation by the committee, to send delegates to Washington for the same purpose?
8. Are you willing to work in behalf of this movement—by writing, lecturing, organizing state committees and other committees, securing resolutions from societies, faculties of universities, etc.?
9. Can you suggest other methods of work?
10. Can you give the names and addresses of secretaries of societies whose members ought to receive the circular and other documents?

SUMMER "ASSEMBLY IN SCIENCE" AT THE SCRIPPS INSTITUTION

THE experiment of holding a "Summer Assembly in Science" at the Scripps Institution for Biological Research at La Jolla, on the sea coast near San Diego, will be tried by the University of California this summer for the first time. The purpose is to disseminate among teachers of biology and physical geography and others interested in modern science the discoveries and new points of view which are resulting from the investigations of this research department of the university, and to

acquaint scientific men with the richly varied sea-life of the California coast.

There will be lectures, conferences and demonstrations every afternoon of the six weeks by members of the scientific staff of the institution on the following subjects (each once weekly). "The Relation of Biology to the Sciences of Man," Professor William E. Ritter, Fridays; "Heredity, Environment and Adaptation," Dr. F. V. Sumner, Thursdays; "Some of the Messages of Marine Biology to Student and Teacher," E. L. Michael, Wednesdays; "Physical Oceanography, Including Some of Its Relations to Meteorology," G. F. McEwen, Tuesdays. "Local Coastal Physical Geography" will be a course to be conducted Monday, Wednesday and Friday mornings, at 10 o'clock by W. C. Crandall, who as master of the *Alexander Agassiz,* the institution's seagoing scientific collecting vessel, has wide familiarity with the California coast. The rest of the mornings of every day except Saturday will be devoted to lectures, laboratory, museum and field work for small groups of students on the characteristic animal and plant life of the ocean waters along the shore of southern California, this work being conducted by W. C. Crandall and P. S. Barnhart.

The university has been encouraged in such undertakings by the success of the annual summer session at Berkeley (for next summer from June 26 to August 5), which last year enrolled 5,364 students.

Half a mile of ocean frontage, with cliffs, sand beaches and tide pools inhabited by a wide variety of sea-life is the ideal location which the Scripps Institution for Biological Research occupies, two miles north of La Jolla and fifteen miles north of the center of San Diego but within the corporate limits of the city. The "investors," as Miss Ellen B. Scripps and Mr. E. W. Scripps prefer to be known, have provided the Scripps Institution with maintenance funds and with a commodious laboratory building containing twelve private laboratories for investigators, a large aquarium room, a two-story concrete museum and library building, now in course of construction; and a concrete pier a thousand feet in length, at which the eighty-five foot collecting vessel, the *Alexander Agassiz,* can dock, and from the end of which, far out beyond the surf zone, pure sea water is pumped in to supply the nineteen tanks in the public aquarium and also the scientific laboratories. The institution possesses a biological library of over 5,000 bound volumes and 8,000 pamphlets and the principal scientific journals in its field, and a museum is being assembled of the marine fauna of the California coast.

"Endowed research in pure science is absolutely essential to continued progress in civilization"—such is the declaration of faith which Director William E. Ritter makes in his announcement of this assembly in science at La Jolla, from June 25 to August 5. "In a democratic country like ours," he continues, "there must be provision for investigation and also definite measures to disseminate the fruits of investigation as widely as possible among the people."

Any persons interested in science who wish to attend the assembly at the Scripps Institution are requested to write as soon as possible to Professor William E. Ritter, scientific director of the institution, at La Jolla, so that proper provision may be made.

THE CLOSING OF BRITISH MUSEUMS

A PROTEST against the closing of British museums (including art galleries) was made to the prime minister on February 10 by a deputation representing the Museums Association, the National Art Collections Fund, the Royal Asiatic Society, the Hellenic Society, the Art Workers' Guild and the Imperial Arts League. Mr. Asquith said that in addition to the reading room of the British Museum, the government had decided to keep open the National Gallery and the Victoria and Albert Museum. In view of the numerous colonial visitors and wounded soldiers who resorted to the Natural History Museum, a further concession might be made by keeping open the portions of the museum which most interest ordinary visitors. Sir E. Ray Lankester writes to the London *Times:*

I am afraid that our legislators are ignorant of

the contents and purposes of the museum, as well as misinformed in regard to the paltry amount really involved in admitting the public. That is more than probable since, when I was its director, I was frequently told by the eminent politicians and other public men—who had unfortunately been appointed trustees of the museum—that they had never visited its galleries, and really felt little interest in its contents. The action of those who desire to pose as economists in making a paltry saving by treating science with contempt can only be explained by their disastrous ignorance.

Lord Morley writes to the same journal in regard to the Natural History Museum:

The saving to be effected would be nearer £2,000 than £3,000 per annum. I need not dwell on the disadvantage to students; that is obvious. Then, as the Archbishop said, not at all too strongly, "there would be a great deal of disappointment to such institutions as convalescent homes in the neighborhood of the Natural History Museum, which had been largely visited by wounded officers and men." Besides these, London has a host of colonial visitors just now, and experience shows that the Natural History Museum is one of the places the best of them most desire to see. Interest in the Elgin Marbles at Bloomsbury may, if ministers like, be more or less of an acquired taste. Interest in and curiosity about the animals, birds, insects and all the other wonders in the collection at South Kensington are simple and natural and instructive. To shut your doors in face of curiosity and interest so general, wholesome, and enlivening as this, for the sake of a few hundred pounds in a budget counted by thousands of millions, seems a singular and not quite a diminutive example of perversity, even in our civilized world's present saturnalia of perversity.

SCIENTIFIC NOTES AND NEWS

THE Hébert Prize of the Paris Academy of Sciences has been awarded to Professor M. I. Pupin, of Columbia University, for his theoretical and experimental researches in electricity.

THE William H. Nichols medal will be presented to Dr. Claud S. Hudson at the meeting of the New York section of the American Chemical Society, on March 10. Dr. Hudson will make an address on "The Acetyl Derivatives of the Sugars."

DR. SIMON FLEXNER, director of the laboratories of the Rockefeller Institute for Medical Research, has been appointed Cutler lecturer at the Harvard Medical School for 1915–16.

DR. BRADLEY MOORE DAVIS, professor of botany at the University of Pennsylvania, has been elected a fellow of the American Academy of Arts and Sciences.

THE committee of the British Privy Council for Scientific and Industrial Research has appointed the Hon. Sir C. A. Parsons, K.C.B., F.R.S., to be a member of the advisory council in place of Professor B. Hopkinson, F.R.S., who has been forced to resign by the pressure of special work connected with the war. The committee has also appointed Professor J. F. Thorpe, F.R.S., to fill the vacancy on the advisory council caused by the death of Professor Raphael Meldola, F.R.S.

DR. HENRY K. BENSON, professor of industrial chemistry at the University of Washington, has been appointed director of the newly established Bureau of Industrial Research, the first such institution on the Pacific coast. One fellowship dealing with a problem of the iron and steel industry and amounting to $2,000 has already been established as a result of the cooperative spirit existing between the bureau and the business men of the Pacific northwest. Other fellowships are contemplated. Men interested in the by-products of the fisheries industries have also assigned one of their problems to the bureau for special investigation. The bureau will attempt to coordinate the research activities already undertaken by the university, with a view to the utilization of the resources of Washington.

DR. FREDERICK H. BLODGETT, since 1912 plant pathologist and physiologist at the Texas Agricultural Experiment Station, on January 1, assumed his duties as pathologist in the Extension Service of the Agricultural and Mechanical College of Texas. The increasing volume of correspondence and the need of definite information by field observations and demonstration projects on disease control will be met by this addition to the staff.

Dr. Isadore Dyer, dean of the college of medicine of Tulane University, and an authority on leprosy, addressed the senate committee on February 17 in Washington on a national leprosorium.

Professor H. V. Tartar, head of the Oregon Experiment Station department of chemistry, has been granted a two-year leave of absence to pursue research work at eastern universities.

An expedition for the study of echinoderms and siphonophores, under the auspices of the department of marine biology of the Carnegie Institution of Washington, will leave New York for Tobago, British West Indies, on March 10. The investigators are Dr. Hubert Lyman Clark, of Harvard University; Professor Th. Mortensen, of Copenhagen, and Dr. Alfred G. Mayer. Professor E. Newton Harvey, of Princeton University, will visit Japan under the auspices of the same agency.

Mr. H. U. Hall, leader of the University of Pennsylvania Museum's expedition to Siberia, has arrived in Philadelphia, after an absence of nearly two years. The expedition covered some hitherto unknown parts of Siberia and experienced a great number of hardships. Many collections of ethnological specimens have been brought home to the museum.

Knud Rasmussen, the Danish explorer, proposes to sail on his next expedition from Copenhagen to Greenland, about April 1. The region he proposes to explore is the desolate country between Peary Land and Greenland, and to the north of Etah, where Donald B. MacMillan and his fellow-explorers are icebound for the present winter.

Professor S. J. Barnett asks us to state that the $300 grant to him from the trustees of the Ohio State University was not made for work on the cause of the earth's magnetism, as reported, but for experiments on the magnetic effects of rotating nickel and cobalt.

At the meeting of the New York Section of the American Chemical Society on March 10, Dr. Carl L. Alsberg, chief of the bureau of chemistry of the Department of Agriculture, made an address on "The Development of the Bureau of Chemistry."

Before the Philosophical Society of Washington on March 4, the address was given by the retiring president, Dr. W. S. Eichelberger, on "The Distances of the Heavenly Bodies."

Dr. Charles R. Stockard, professor of anatomy in the Cornell University Medical College, gave, on March 1, the second in a series of public lectures before the Yale Chapter of Sigma Xi. His subject was "Experimental Studies on the Influence of Alcohol in Development and Inheritance."

Dr. George T. Moore, director of the Missouri Botanical Garden, delivered recently an address before the Massachusetts Horticultural Society at Boston, on "The Missouri Botanical Garden."

The next Harvey lecture at the New York Academy of Medicine will be given Saturday evening, March 11, by Professor Henry A. Christian, of Harvard University, on "Some Phases of the Nephritis Problem."

Dr. Louis Duncan, of the consulting engineering firm of Duncan, Young and Company, New York City, distinguished for his work in applied electricity, associate professor of applied electricity at the Johns Hopkins University from 1887 to 1899, and head of the department of electrical engineering at the Massachusetts Institute of Technology from 1902 to 1904, has died in his fifty-fourth year.

Charles G. Carroll, Ph.D. (Johns Hopkins), for the past eleven years head of the department of chemistry, University of Arkansas, died at Fayetteville, on February 23, of tubercular meningitis.

Dr. Henry Baird Favill, professor of clinical medicine in the Rush Medical College and professor of medicine in the Chicago Polyclinic, died from pneumonia on February 20, aged fifty-five years.

A. S. Marsh, who held a studentship in botany in Caius College, Cambridge, and had made valuable contributions to plant ecology, has been killed in the war.

DR. FRANCIS WYATT, of New York City, an authority on fermentation and brewing, has died at the age of sixty-one years.

PROFESSOR JOHAN CHRISTIAN MOBERG, of the University of Lund, the distinguished paleontologist and stratigrapher, died on December 30, 1915, at the age of sixty-one years.

NEWS has been sent us of the death of Alan Owston, naturalist and merchant, of Yokohama. Mr. Owston was born in England in 1853 and, while a boy, went to Yokohama, where he was engaged in a general export and import business. In connection with this, however, he undertook deep-sea dredging, fitting up different yachts, the best one being the *Golden Hind,* with which he made numerous explorations of the deep sea. Among other things, he discovered many new species of fishes. These have been described by Dr. Jordan and his associates, Dr. Gilbert and Professors Snyder and Starks, and by Dr. Tanaka, of the Imperial University of Tokyo. Part of his collections are in the National Museum and the British Museum, but the bulk of them has been purchased by the Carnegie Museum of Pittsburgh. In addition to his work as a naturalist and explorer of the deep sea, Dr. Owston took a very deep interest in the cause of national peace, writing under the pen name of "Asio," numerous articles in Japan in opposition to the war system. Recently he became one of the editors of a journal known as *Commercial Japan.*

MR. WARREN K. MOOREHEAD, of Andover, Massachusetts, is preparing a volume on Indian stone ornaments and problematical forms. He will be glad to receive communications from museum curators and those interested in technical study of prehistoric stone ornamental objects and the distribution of such forms. Mr. Moorehead will present a number of maps showing areas in which ornamental and problematical forms known as banner, winged and bird stones, charms and amulets, etc., are found. The relation of these to the distribution of linguistic stocks will be indicated.

THE President of the United States has issued a proclamation, dated February 11, stating that whereas, certain prehistoric aboriginal ruins situated upon public lands of the United States, within the Santa Fe National Forest, in the state of New Mexico, are of unusual ethnologic, scientific and educational interest, and it appears that the public interests would be promoted by reserving these relics of a vanished people, with as much land as may be necessary for their proper protection, therefore a national monument is established to be known as the Bandelier National Monument.

THE department of chemistry of the College of the City of New York announces special lectures to be given at 3 P.M., as follows:

March 10—"Food Control in New York City," by Mr. Lucius P. Brown, director, Bureau of Food and Drugs, Dept. of Health, New York City.

March 17—"The Extraction of Radium from Its Ores," by Dr. Chas. L. Parsons, mineral technologist, United States Bureau of Mines.

April 7—"Chemical Control of Medical Supplies Purchased for the United States Army," by Lieutenant D. W. Fetterolf, Medical Relief Corps, United States Army.

April 14—"Science in the Humanities," by Mr. Elwood Hendrick.

May 5—"The Emancipation of American Chemical Industries," by Dr. Thomas H. Norton, commercial agent, U. S. Department of Commerce.

May 12—"Food Poison," by Mr. James P. Atkinson, chemist, Food and Drug Laboratory, Department of Health, New York City.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Illinois has purchased for its school of pharmacy a new site located at the corner of Wood and Flournoy Streets, Chicago, immediately opposite the new Cook County Hospital, and affording a frontage of 201 feet on Wood Street and 128 feet on Flournoy Street. The purchase includes two substantial brick buildings erected for the Chicago Homeopathic Medical College and Hospital some years ago. These buildings will be put into shape at once, and it is expected that the school will remove to its new quarters

immediately following the close of the present school year. The new location is in the great medical center of Chicago and only a short distance from the medical and dental colleges of the university, which will bring its three Chicago departments into much closer relations.

An endowment of $50,000 to support graduate fellowships for Canadians in the American University, Washington, has been made by the estate of the late Hart A. Massey, of Toronto, who desired to establish, if possible, some link between the Methodism in Canada and the United States.

Mr. C. E. Probyn has bequeathed the residue of his estate, amounting to about £10,000, to the University of Bristol.

Nature quoting from the *Pioneer Mail* states that the staff has now been selected for the Lady Hardinge Medical College and Hospital at Delhi, which Lord Hardinge opened on February 17: Principal and professor of medicine, Dr. K. A. Platt; professor of anatomy and gynecology, Miss Hitton; professor of pathology, Miss Field; professor of anatomy, Miss Murphy; professor of chemistry, Miss A. M. Bane; professor of biology and physiology, Miss M. R. Holmer. It is expected that tuition will begin next September, and the government of India will contribute a lakh of rupees (about $33,500) yearly to the annual maintenance charges.

Dr. Roscoe Pound, Carter professor of jurisprudence, has been appointed dean of the Harvard Law School. Dr. Pound is known to scientific men for his studies of the phytogeography of Nebraska. He is a member of the Botanical Society of America and a fellow of the American Association for the Advancement of Science. Dr. Pound was a member of the Committee of the American Association of University Professors which drew up its Report on Academic Freedom and Academic Tenure.

Professor Eliot Blackwelder, of the University of Wisconsin, has been called to the headship of the department of geology at the University of Illinois.

DISCUSSION AND CORRESPONDENCE

CROWN GALL OF PLANTS AND CANCER

Recently I have made discoveries which tie crown gall of plants closer to cancer of man and animals. I can now produce embryonic teratomata at will by bacterial inoculations. All that is necessary is to inoculate growing plants in areas containing dormant totipotent or pluripotent cells, using *Bacterium tumefaciens*. Moreover, as in man, daughter tumors are produced freely and these also contain teratoid elements. These results have been obtained repeatedly during the last two months on *Pelargonium*, tomato, tobacco and citrus. A full account will be published within a short time.

Erwin F. Smith

Washington, D. C.,
March 3, 1916

THE RISE OF SEA LEVEL SHOWN BY COASTAL DUNES

In a paper[1] published in the second annual report of the state geologist of Florida, in 1909, the writer called attention to sand dunes on the coast of southern Florida and the relation of these dunes to present sea level. It is altogether possible that others have noted the value of the evidence shown by coastal dunes as indicating changes of sea level with respect to the land, but the writer has not seen any references to the matter, and for that reason mentions it again.

Dunes may be divided into two classes—active and quiescent. Active dunes are those that are still growing, fed by supplies of wind-blown sand from some nearby expanse. Quiescent dunes are not growing, and are covered with vegetation. A good example of an active coastal dune is the great dune at Cape Henry, Va. Good examples of quiescent dunes may be found at many points along the Atlantic coast.

At some quiescent dunes close to the shore the writer has observed that a dune, as shown by its shape and the stratification of its sands, grew under conditions that no longer exist,

[1] Sanford, Samuel, "Topography and Geology of Southern Florida," page 184.

there being now a swamp to windward; also, as in Florida, there may be outlying keys, or, as at many places, beach ridges, the keys or beach ridges being higher than the swamp and consequently higher than the old beach or sandy expanse from which the dune grew.

Evidently, such quiescent dunes furnish positive evidence of a rise of sea level. Also, it is clear that this change of sea level must be of Recent or of latest Pleistocene age, the position of the dividing line between Pleistocene and Recent time being necessarily a matter of opinion, for the dunes can not be old. Even those of Florida, which indicate a rise of sea level of at least five or six feet at their bases, rest on late Pleistocene marls and limestone. The exact age of the dunes and the exact length of time that has elapsed since they became quiescent by the growth of swamps cutting off supplies of sand, are alike indeterminable, but the sharpness of characteristic outlines and the size of the trees on many of them indicate quiescence for hundreds, but not for thousands of years.

A locality where this relation between swamp growth and dune quiescence may be conveniently observed by many persons is at Ventnor, N. J., on Absecon Island, south of Atlantic City.

It is believed that the evidence of the dunes mentioned confirms that of shore-lines, beach ridges, and coastal swamps, namely, that the Atlantic coast of the United States has subsided, or the sea level has risen, in Recent time, and that the change of sea level is probably still in progress.

Evidently, also, termination or interruption of growth by a near-by rise of water level is not restricted to dunes along the sea shore, but applies to all dunes.

S. SANFORD

WASHINGTON, D. C.,
December 20, 1915

A REPUTED SPECIFIC FOR BLACKWATER FEVER

I HAVE in my herbarium two curious plants from the interior of Venezuela, which are of special interest because of their chemical properties. They were collected and presented to me by Dr. Jesus Maria Piñango at Guanoco, Venezuela.

The first specimen is used by the natives of eastern Venezuela as a specific for the dreaded blackwater fever. The plant grows in swamps and reaches a height of six feet. It bears ovate, opposite, entire leaves, tapering to a long point. When boiled to use for fever it colors the water rose-pink.

I should like to invite any reader of SCIENCE who is an expert in therapeutics, and would be interested to analyze and test the properties of this plant to communicate with me, and I will gladly send a specimen for this purpose. For if this plant really possesses the medicinal properties ascribed to it, it might be of much value in the treatment of the blackwater fever, which is so fatal in parts of Venezuela and still more prevalent and deadly in tropical Africa.

The other specimen is a very powerful narcotic. It is called by the Guarauno Indians *Charapu*; and is used by them for poisoning fish in the following manner. A quantity of the leaves are gathered and pounded down into a small hole in the ground so as to form a ball. This is then dried. On going fishing in a river or stream, one man takes this ball of leaves, dips it in the water and rubs it in his hands like a cake of soap. The rest of the party, with scoops and baskets, stand a short distance down stream. Almost immediately the fish become *locoed,* rise to the surface, swim wildly in circles, then become insensible, and are easily secured and gathered into the baskets, so powerful is the narcotic principle of the *Charapu.*

CARLOTTA JOAQUINA MAURY

UNIVERSITY REGISTRATION STATISTICS

TO THE EDITOR OF SCIENCE: In the case of Washington University, the comparison of the University Registration statistics published in SCIENCE, January 21, 1916, with those published for the year preceding, shows a loss in the total number of students in that institution. Actually, Washington University had an increase; 174 in the degree conferring departments alone. This apparent loss is due to a change in the classification of a certain

group of students, as reported to me by the university.

These students, numbering 308, were classified November 1, 1914, under "Other Courses," and were included in the total for the university. Unfortunately, for November 1, 1915, the same group of students, numbering 607, were classified under "Extension and Similar Courses"—a classification not included in the total. This makes the discrepancy in the comparison of totals and accounts for the apparent loss reported.

Professor James Sutton, recorder of faculties of the University of California, reports that of the 3,317 students listed in the statistics in Science of January 21, 1916, under "College," 174 are students in the school of architecture.

John C. Burg

Northwestern University

QUOTATIONS

SCIENCE ON THE WAR PATH

No unofficial war document thus far published can compare in importance with the manifesto issued yesterday on the subject of our national neglect of science. The signatories include many of the foremost scientific names of the day. The arguments are crushing in their conclusiveness. Best of all, if it is permissible so to speak, the manifesto is issued at a time when we are face to face with the most lurid of object lessons. The bulk of our failures in the war have been a consequence of our neglect of that scientific energy, strenuousness and organization of which the Germans make so much. We believe their achievements in this field are exaggerated. At the same time, they are far too obvious for us to remain undisturbed by them unless we mean to resign our ancient place in the world.

The signatories of the scientific manifesto point out that our highest ministers of state are mostly ignorant of the obvious facts and principles of "mechanics, chemistry, physics, biology, geography and geology." It will be noted that economics is not included, possibly because it is regarded as a department of biology. The same ignorance, as the scientists say, runs through the public departments of the civil service, and is nearly universal in the House of Commons. Its existence has been demonstrated by the announcement, on the part of a member of the government, that the possibility of making glycerine from lard was a recent discovery. Doubtless some other minister will shortly allude to the law of gravitation or to spectrum analysis as phenomena which have recently come within the cognizance of the government. The remedy for this state of affairs, in the opinion of the distinguished scientists, "is a great change in the education which is administered to the class from which public officials are drawn." Science should play a larger part in the civil servants' examinations, to the exclusion of Latin and Greek. "Eventually, the Board of Trade would be replaced by a Ministry of Science, Commerce and Industry, in full touch with the scientific knowledge of the moment." In those circumstances, the manifesto goes on to say, with an optimism which is almost pathetic, "public opinion would compel the inclusion of great scientific discoverers and inventors as a matter of course in the Privy Council and their occupation in the service of the state." But if the Privy Council is to be filled up with scientific discoverers, how are party hacks and political schemers to be rewarded for their sycophantic services where they can not afford to pay the price for a knighthood or a peerage?

About the peremptory necessity of better scientific organization on national lines there can be no two opinions. It is not only a question of our prosperity, but of our existence. The law of the survival of the fittest works just as inexorably among nations as it does among individuals. We can be the fittest if we like. Unless we *do* like we shall not survive. But if we are to tackle seriously this problem of scientific reorganization, we shall have to scrap the whole of our rotten and antiquated political machinery. The scientific mind and temper can not possibly flourish in an atmosphere of political trickery, nepotism and plunder such as that which has surrounded us for the last few centuries. For

instance, what is the first characteristic of the true scientific spirit? Surely, the desire to ascertain the whole of the facts, and then to pass an unbiased judgment upon them. The true scientist, secure of his data, will follow his intellect whithersoever it leads him. But these principles are reversed under the House of Commons. In what should be the assemblage of the best national intellect there is no place for intellect at all. No private member of the House of Commons is allowed to pass an independent judgment on facts, scientific or otherwise. Before the data are submitted to him he is told what his opinion must be. If he can not quite make up his mind, he taps humbly at the door of the whip's office and is there told what he thinks. The greatest of all scientific achievements is possibly the Newtonian principle that every portion of matter attracts every other portion of matter in the universe with a force proportionate to the respective masses, and inversely as the square of the distance. If, in normal times, the House of Commons were ordered by the whips of the predominant party to pass a resolution that Newton was wrong, and that "every atom of matter in the universe repels every other atom, conversely as the circle of the distance" (whatever that may mean), the members would file into the division lobby with their customary subservience. In normal political circumstances the House of Commons will pass anything, no matter how mischievous or ludicrous if it is ordered so to do. When the national sovereignty is in the hands of such an assemblage of unintellectual automatons as that, he who anticipates legislative sympathy with scientific achievement might with equal prospect of satisfaction hope to taste green cheese from the moon.

Very much the same may be said of the civil servants. All the highest posts are filled by private "influence." They go to the ex-private secretaries of ministers and to the sons, sons-in-law, brothers-in-law, nephews, cousins and other relatives of the men who are already "bosses" in the various departments. Talent and distinction are boycotted. Suppose the greatest of scientific discoverers—a Darwin or a Wallace—to be in rivalry as candidate for a high position in the civil service with some young ass who happened to be the intended son-in-law of a minister or "commissioner." The scientist might as well retire from the contest. The young ass would get the position and a few thousands a year with it. If he were hopelessly unable to discharge the duties, a competent deputy would be engaged at the expense of the taxpayers. That system fills the civil service with the offscourings of incapacity. Years ago Sir Charles Trevelyan said:

> There is a general tendency to look to the public establishments as a means of securing a maintenance for young men who have no chance of success in the open competition of the legal, medical and mercantile professions . . . the dregs of all other professions are attracted towards the public service as to a secure asylum.

Thanks to this wicked system, it was recently announced that no less than five masterships of the High Court had been bestowed by "influence" on the sons of judges, to the exclusion of hundreds of better-qualified men, who, unfortunately, had not been fathered from the bench. When the administration of justice is itself tainted with nepotism, and when the dregs of every profession are appointed to the highest positions in the public service as a result of private "influence," we have a long way to go before scientific achievement, no matter how distinguished and beneficial, will count for much in this country.

There are, however, some encouraging signs. The political truce is opening the eyes of the public to the stupidity of allowing the British Empire to be run in the interests of political schemers and lazy bureaucrats. Three or four years ago it was a common belief that our insane party system was an essential of effective government. That delusion is gone forever. We are now beginning to understand that an Empire is run on precisely the same lines as a great business. The partners of a great commercial undertaking would not tolerate the presence among them of a man who, like a politician, announced his opposition to proposals before he knew what they were or who,

like a bureaucrat, was incessantly plotting for his own hand and pocket against the interests of the partnership. True science and politics are incompatible. They can not exist together any more than the eagle and the squid can share the same apartment. Science has at this moment the most magnificent opportunity that it has ever enjoyed of seizing the steersmanship of human destiny. Every man who wants to see his country great, progressive and prosperous, marching as a standard-bearer at the head of the advancing legions of mankind, should back the scientists with every ounce of energy that he possesses. If, otherwise, he wishes to see her mean, petty, retrogressive, squalid and contemptible, let him support a return to our debasing party strifes, with their concomitant triumph of the political schemer and all the host of parasites whom he enriches out of public money.—*London Financial News.*

SCIENTIFIC BOOKS

Die Grundlagen der Psychologie. Von Theodor Ziehen. Leipzig und Berlin, B. G. Teubner, 1915. 2 volumes. Pp. vi + 259; vi + 304. Price M. 4.40, geb. M. 5.

Professor Ziehen, long known to psychologists as the author of a very readable "Introduction to Physiological Psychology," has undertaken in his latest work to determine the fundamental principles of psychology. According to his view the science rests upon a twofold basis, its epistemological foundation, and the basal principles of the science itself. The latter may be investigated "autochthonously," that is, with respect to the psychical alone, or in correlation with non-psychical material. The latter investigations furnish the psychophysical and psychophysiological foundations of psychology. In the present work only the epistemological and autochthonous principles are discussed—each in a separate volume.

The author's epistemological standpoint is rigidly phenomenalistic. He starts with the totality of the Given (das Gegebene), which he calls the Gignomene. This primary datum is divided into two fundamental classes, sensations and representations (Vorstellungen). The latter are derivatives of the former. The psychical, which constitutes the subject matter of psychology, is to be regarded as the totality of the Given in relation to a certain "component" of the sensations and representations.

Every sensation datum can be analyzed into two constituents, a "reduction" component and a parallel component. The former is subject to a certain sort of variation—successive changes—and such partial variations constitute the causal series. The second component is subject to a different sort of variation—simultaneous changes—which form the parallel grouping of data. The parallel group includes both independent and dependent variations. The independent variations, so far as we know, occur only in the brain and nervous system. All sensations are subject to dependent variation. Thus among our sense data there are some which stand only in causal and *passive* parallel relations to other data, and some which manifest *active* parallel relations as well—that is, data which produce parallel *effects*. The representative data are resolvable into components analogous to those of sensations. Psychology, according to the author, is the science of the passive parallel components of experience. Such, in bare outline, is Professor Ziehen's demarcation of psychology. Unfortunately, in spite of his endeavor to give mathematical precision to the analysis the meaning of his fundamental terms remains somewhat in doubt.

The fourth chapter contains a very incisive discussion of the historic theories of the Self. The author finds no sufficient ground for assuming the existence of a soul-substance or mind-stuff. The self is merely "an individual collective concept, distinguished by special characteristics" (I., 140). The existence of "other selves" he believes to be comprehensible from his standpoint, while the substance theory, carried out logically, lands us in solipsism.

In Chapter 5 the relation of the "psychical" to the brain is examined. The classic theories, which he designates as causalism, parallelism, materialism, spiritualism, identism and logis-

tical unitarism, are all set down as dualistic. His own solution of the problem is that "the psychical and the material are not two distinct entities, but denote two different kinds of regularity—parallel regularity and causal regularity" (I., 150).

The following chapter treats of consciousness. In common usage the term *consciousness* has three essentially different meanings: it denotes (1) a substantial unitary "self" or "soul," (2) a specific process or function in the psychical sphere, (3) a specific property of the psychical. None of these uses appears satisfactory. According to the author, as already stated, "the psychical denotes not a specific entity, but merely the Gignomene in so far as the latter includes parallel components in accordance with the parallel laws" (I., 206). The notion of unconscious mental processes is not only self contradictory, but it is quite superfluous from his viewpoint. On the other hand, the "reduction constituents" of the datum are unconscious, and in this sense the term "unconscious" has a valid meaning. The first volume concludes with a discussion of the relation of psychology to logic, esthetics and ethics.

In the second part Professor Ziehen develops the autochthonous foundations of psychology. He recognizes both the objective and the subjective methods of research, including under the latter self-observation and observation of others. But according to his view "introspection" is not a special process: it is rather an associative mode of succession of mental processes. The introspection of a sensation is a representation corresponding to that sensation, and the representation of a representation is merely a repetition of the latter. Both induction and deduction are appropriate methods of investigation in psychology proper, whereas in psychophysics and psychophysiology only induction is admissible. Under induction he includes the genetic and experimental methods, but considers the questionnaire method a caricature of the true experimental procedure.

The aim of psychology may be either general or individual. Under general psychology he includes anthropological psychology, animal psychology, and the special fields of general mass psychology and the psychology of types. Under individual psychology he notes one special field: special mass psychology.

The remainder of the work is devoted to an examination of the psychical subject-matter. The two universal characteristics of the psychical are temporality and variability. At the outset the author had divided the primary datum into sensory and representative Gignomene. Whether or not this classification is exhaustive can only be determined by analysis of every sort of experience. Taking up the various types of experience which psychology has recognized as fundamental, he proceeds to show that they are all reducible to sensations and representations, or transformations of representations, or their simultaneous and successive combinations. The author's analysis of judgment, feeling and volition is especially thorough and interesting. Judgment is resolved into a particular sort of representation. The hedonic experiences, instead of forming a third distinct group of data, are found to be merely specific properties of sensations and representations. Volitions are reducible to certain combinations of sensory and representative data—namely, those in which a strong pleasure-tone is united to the representation of a "purpose."

Professor Ziehen's book will interest the psychologist of a speculative turn of mind. His attempt to resolve the data of experience into causal and parallel components is a definite contribution to the mind-body problem. To the present reviewer, though he differs with the author in standpoint, the theory appears to be developed logically from plausible premises. The obscurity of language in the early part of the analysis may be due to the difficulty of defining fundamental ideas such as reduction-component, etc., or it may be the result of attempting to treat non-mathematical terms by means of algebraic symbols and operations. Whatever the reason, the analysis here is exceedingly difficult for even the psychologist to comprehend. It is doubtful whether the physicist and physiologist, to whom these

concepts are quite novel, will be able in general to follow the author's reasoning.

Howard C. Warren

Princeton University,
February 8, 1916

The Permo-Carboniferous Red Beds of North America and Their Vertebrate Fauna. By E. C. Case. Carnegie Institution of Washington.

In this monograph Dr. Case has summarized our knowledge to date of the vertebrates from these Permo-Carboniferous beds, which, for a period of over forty years, have been yielding remains of essential interest to paleontology; because the beds, laid down at a time when the amphibians were dominant and the reptiles were in the transitional stages, have preserved the most complete skeletons of these early vertebrates, and it is essential to know these Cotylosaurs, Pelycosaurs, etc., in order to attain a correct idea of the further development of the reptiles and the ancestry of the mammals.

His careful description of the beds and localities invites and clears the way for those who shall follow and collect in these beds, the tedious search for favorable localities and horizons, which hampered the pioneers in this field, being removed by the submission of all this data to the public; and it is a hard field, the fossils being scarce and fragmentary. Then his conclusions from the character of the beds as to the climates and environment are a great aid in the efforts to interpret evolution.

Case gives the range of this fauna as from the Pittsburgh Red Shales in the middle of the Upper Pennsylvanic (Missourian) to the top of the Clear Fork, which is about the middle of the Permic, as described by Schuchert. At this point in time the dominance of this fauna ends in America, though in Europe, it, or an equivalent fauna, runs up into the Triassic.

It is shown that all the amphibians of the fauna are carnivorous, the reptiles partly carnivorous, partly molluscivorous, and partly insectivorous. None were adapted to marine life; none were far advanced even toward fresh water life; but the fauna is typically one of the estuaries, swamps, alluvial plains and woodlands.

The eighth chapter presents summary descriptions of the best-known genera, illustrated by 23 restorations, which impress the reader with the heavy, slow-moving character of most of these animals, though the drawings leave something to be desired in life-like appearance.

An appendix gives a description of the Brier Creek Bone Bed and its fauna, the locality which has yielded the richest finds of Permo-Carboniferous vertebrates. Some twenty plates show detail photographs of the beds and fossiliferous strata, which will aid any one studying the conditions of deposition, or going into this field, so that with the minimum of experience they can get the best results.

As a whole the volume is one which will ably serve any student of the Permo-Carboniferous, as it brings him up to the present, and will long serve as the starting point for further studies of these beds.

F. B. Loomis

Amherst College

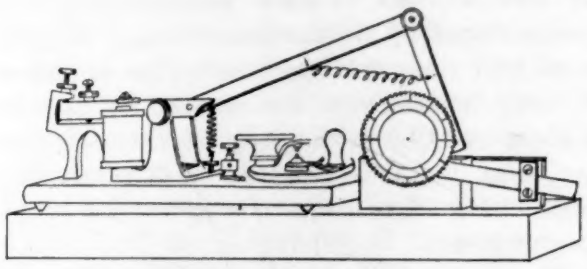
SPECIAL ARTICLES

AN ELECTRIC COUNTER FOR DETERMINING THE RATE OF A FREE-SWINGING PENDULUM

A heavy pendulum, vibrating through small arcs, and unconnected with clockwork or escapement, possesses several advantages for recording time in graphic experiments. It is simple, and easy to construct, and is more accurate than some more complicated apparatus used for this purpose. Its especial merit is that its consecutive swings are so perfectly isochronous that it can be employed for testing tuning-forks and other vibrating recorders. In testing tuning-forks and in similar work it is absolutely necessary that the time intervals should be equal. As the vibrations of the pendulum of a clock are liable to be affected by irregularities in the action of the motive power, it is possible that they may not be perfectly isochronous when their number in a considerable period of time is correct. This objection does not apply to the free-swinging pendulum.

The chief obstacle in employing a free-swinging pendulum for graphic purposes is the difficulty of determining its rate. The methods of coincidence devised by physicists necessitate the use of a standard clock, and are somewhat complicated. The writer has constructed a simple apparatus for recording the exact number of beats in the period tested, which has given very satisfactory results. The figure shows the essential details of its construction.

The common base of a telegraphic sounder and key is fastened to a larger board. A counter for registering rotation is screwed to a small block, with its axis at right angles to the lever of the sounder. A brass disc with 60 ratchet teeth is attached to the end of the axis. The movements of the lever of the sounder are



communicated to the toothed wheel by two strips of steel which are connected by a joint. The first strip is fastened to the right-hand end of the lever with a screw. A pin projects at right angles from the lower end of the second strip. This pin is shaped to fill the interval between two teeth, and acts both as a pawl and an index. The front face of the disc is divided by radial lines which mark the position of every fifth tooth, the tenths being designated by longer lines.

The sounder is placed in the circuit, which is periodically closed and opened by the pendulum that is being tested. When the lever is pulled down by the electromagnets the disc is rotated to the extent of one tooth, and every complete rotation of the wheel is registered by the counter. To prevent the disc from advancing too far when it is suddenly pulled forward, and from recoiling when the pawl moves backward, a clock spring, fastened to a second block, is pressed against the back of the wheel by a screw with a milled head passing through the block. This screw does not appear in the sketch. The degree of pressure required by varying conditions is regulated by experiment. The index is pressed against the wheel by a delicate spiral spring stretched across the angle of the arm. The extent of movement of the arm is regulated by the two screws at the left of the figure. The dropping of the pawl is due to the spring attached to the end of the lever, the tension of the spring being regulated by the screw to which its lower end is fastened. Pieces of paper are placed between the armature and the magnets in order that the lever may return with sufficient rapidity to its original position. When it is desired to use the sounder without the counter, the screw which clamps the arm to the lever is loosened, the arm elevated a little, and the screw again tightened.

The electric counter should be used with a reliable time-piece indicating seconds. The zero mark on the disc is set opposite the index-pawl. When the second hand of the watch is in the desired position, the horizontal lever to which the right hand knob is attached is thrust beneath the spring, which closes the circuit. While the instrument is in operation, the instant when the zero notch is closed by the index is noted from time to time. If at the end of an hour no variation between the indications of the disc and the watch can be detected, the seconds pendulum is considered accurate enough for testing purposes. It should have an error less than one half second in an hour. In using this coincidence method in regulating the rate of the pendulum it is not necessary to read the counter. The counter is only indispensable in finding the number of vibrations when the rate is unknown.

The seconds pendulum which I have employed in my experiments oscillates upon knife-edges of hardened steel, and has a bob weighing 2.4 kilograms. A platinum wire in the lower end of the rod makes contact periodically with a globule of mercury. The length of the tangent of one degree of arc described by the wire in the end of the rod is two centimeters. By holding a millimeter scale horizontally by

the side of the contact it is easy to displace the pendulum one degree, making the arc of vibration two degrees, which is sufficiently great for testing the apparatus an hour.

As the tuning-fork is the standard instrument for measuring and recording short periods of time in physical and physiological experiments, it is very desirable that its exact rate of vibration should be ascertained under the conditions to which it is subjected. It is necessary to employ the graphic method to do this successfully, for the friction and weight of the writing point are liable to affect the rate. A record of considerable length should be taken to minimize the errors due to irregularities in the action of the electric contact. In my own work the smoked paper for the tracing envelops a light aluminium drum which is rapidly rotated by hand. The drum is mounted on a steel axis with a spiral groove cut in it. A pin projecting into the groove causes the drum to rotate in a spiral. As the spiral movement allows long records to be taken, the mean number of vibrations for a considerable period can be ascertained. The motion by hand is very satisfactory, as the rate of rotation can be varied as required. The time-marker in the circuit of the pendulum should write only a few millimeters from the tracing of the fork. In order to do this it is necessary that the axis of the marker should make an angle with that of the fork. I use a clamp for this purpose which holds the object in any position, and permits a delicate adjustment of the writing point. The records that have been obtained with the apparatus have been very regular; variations of small fractions of a vibration were easily detected in them.

Frederick W. Ellis
Monson, Massachusetts

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION M, AGRICULTURE

The second meeting of the Section of Agriculture was held in Townsend Hall, Ohio State University, Columbus, December 28, 1915. The sessions were presided over by the vice-president of the section, Dean E. Davenport, of Illinois. The two features of the meeting were the address of the retiring vice-president, Dr. L. H. Bailey, upon "The Forthcoming Situation in Agricultural Work," already published in Science,[1] and a symposium on "The Relation of Science to Meat Production." The latter was participated in by five speakers who presented various phases of the subject. These papers brought out clearly the complicated and many-sided nature of the problem of meat production and the part which science is playing in promoting, safeguarding and rationalizing the industry.

The symposium was led by President W. O. Thompson, of Ohio State University, who defined "The Nature of the Problem." The background of it lies in the fact that the people of this country have been a meat-eating people for many generations, and any limit to the supply or any excessive cost calls forth widespread protest. The problem of meat production was defined to be largely an economic one in farm management. It has been affected by the numerous changes in agricultural conditions over the country, the extension of farming in the west, the increase in the tenant system, and the development of the dairy industry, even in the vicinity of small towns, all of which have affected the raising and fattening of beef cattle.

The large risk sustained in live-stock keeping has contributed another angle, as has also the problem of advantageous marketing. The problem of maintaining the requisite meat supply is not a haphazard one, but includes very definite phases, such as its relations to systems of farming and to the maintenance of soil fertility, the maintenance of health of live stock to reduce the risk, provision of adequate marketing facilities and conditions, and the intelligent feeding and handling of meat animals. The point was emphasized that the taste for meat has been struggling for existence at the expense of the farmer, and that consideration of the problem of continued supply must be based on broad considerations, in the firm belief that the laborer shall receive his reward.

President H. J. Waters, of the Kansas Agricultural College, enumerated some of the ways in which science may help live-stock farming, as by showing the farmer how a surplus of feed may be carried over, in the silo for example, to equalize the feed supply from year to year; by the proper balancing of feeds, a knowledge of the values of

[1] 1916, Science, N. S., Vol. XLIII., p. 77.

protein from different sources and of the relation of mineral constituents to efficient nutrition, growth and reproduction. Breeding offers further opportunity for improvement, and science may also help the farmer to meet the changes in the demand of the market, as for example, for bacon and ham hogs in place of those furnishing a larger proportion of pork. Already there is a basis for a much better understanding of these matters as a result of recent investigation. Furthermore, a better understanding of factors of growth may assist in cheapening meat production. Investigations upon the stunting effect of deficient food supply has shown the practicability of allowing animals to grow when the farmer has feed for them, and maintaining them on a low basis of nutrition when feed is scarce. The retardation of growth was not found so serious as was formerly thought.

President Waters emphasized the fact that meat production must yield a larger net profit than grain and hay farming to induce farmers to follow it, since it involves more work, more risk, and keeps farmers employed the year round. Any increase in meat production, he prophesized, must come from home production, on the farm mainly and not on the western ranges.

The latter point was borne out by Professor H. W. Mumford, of the University of Illinois, who discussed "The Problem of Meat Production on the High-Priced Lands of the Middle West." He held the corn-surplus states to be the natural center of beef production in this country, since corn-fed cattle are the distinctive feature of the cattle industry and cattle raising in the corn belt provides a farm market for the crop and conserves the fertility of the soil. As a result of changed conditions, however, a large per cent. of the cattle fed in these states are raised in the great breeding grounds of the southwest. Consequently, the business of cattle feeding or finishing has gravitated into the hands of large feeders who deal in carload lots, the capital, risk and business skill involved and the distance from markets having deterred many farmers from going into this line.

In order that beef production in the corn belt may take its proper place it was deemed advisable that the business should be distributed more generally among farms of average size, and that an increasing proportion of the cattle fed in the corn belt be reared there. Further development of the industry was said to depend on a remunerative and reasonably stable market, and no prospect was held out of lower prices. It was prophesied that any considerable increase in the production of beef cattle in the United States will come from the establishment of small herds on many farms rather than of large herds on extensive areas.

"The Economic Aspects of Meat Production and Marketing" were treated by Professor L. D. Hall, of the U. S. Department of Agriculture. The marketing of live stock, particularly of hogs, is coming to be regarded as the limiting factor of their production. The problem of marketing was stated to relate in very large measure to the great central markets, at which more than half of the cattle, two thirds of the swine and approximately four fifths of the sheep of the country are slaughtered. Several conditions and practises which further complicate the problem and favor the buyer were enumerated.

The speaker explained that "every effort should be exerted to take up the slack in a system that contemplates raising a steer in Texas, grazing him in Montana, fattening him in Iowa, selling him in Chicago, slaughtering him at New York, and sending surplus fresh cuts in refrigerator cars as far west as the Missouri River." One feature of the problem was the supplementing of the large central slaughtering establishments with other facilities tending to make markets more accessible to producers, and a tendency in that direction was noted. Furthermore, the provision of more complete official information for growers and feeders as to the supply and distribution of meat animals, both fat stock and feeders, the movement of live stock, quotations at various markets based on standard classes and grades, and the stocks of fresh meat and meat products at principal points, it was maintained would contribute very materially to the stability of conditions and give the producer a truer understanding of the economics of his business.

Dr. A. R. Ward, of the Bureau of Animal Industry, discussed disease control as a factor in meat production, enforcing his remarks by data drawn from the federal inspection of meat and meat animals. He showed the enormity of the direct loss from animal diseases, estimated to amount to approximately $212,000,000 annually, a large proportion of which is from diseases demonstrated to be preventable and controllable. Nearly two per cent. of the animals slaughtered under federal inspection in 1914 were condemned in whole or in part on account of disease. The burden which these losses imposes upon the meat-producing industries of the country was emphasized.

Tuberculosis caused the largest number of condemnations and hog cholera the next. The blighting effect of Texas fever upon a large section of the country was referred to, and the success in the campaign for eradicating the tick causing the disease was pointed out. The results are already apparent in an extension and improvement of the cattle industry.

The importance of the control of animal diseases in relation to the production of meat and the live-stock industry was summed up in the statement: "The good judgment and knowledge possessed by the individual producer of animal-food products concerning the diseases of his animals will determine his success."

The officers elected for the coming year were as follows: Vice-president, Dr. W. H. Jordan, director of the State Agricultural Experiment Station, Geneva, N. Y.; Dean F. B. Mumford, of the University of Missouri, a member of the council, and Dean Alfred Vivian, of Ohio State University, a member of the sectional committee (for five years).

E. W. Allen,
Secretary
U. S. Department of Agriculture

THE AMERICAN SOCIETY OF NATURALISTS

The thirty-third annual meeting of the American Society of Naturalists was held at Ohio State University, Columbus, on December 30, 1915. In affiliation with the society this year were the American Society of Zoologists and the Botanical Society of America.

The report of the treasurer, stating a balance on hand of $676.14, was accepted.

The two following resolutions were adopted.

1. *Resolved,* That the American Society of Naturalists recognizes the urgent need in the United States of reform in the methods of securing evidence of expert opinion in judicial procedure; That the American Society of Naturalists approves the efforts of the American Association for the Advancement of Science in this behalf; and, That the executive committee is hereby authorized and directed to cooperate with the committee of the American Association for the Advancement of Science in the endeavor to bring about such reform.

2. *Resolved,* That the American Society of Naturalists, recognizing the centigrade scale of temperature measurement as based on better principles than that of the Fahrenheit, emphatically urges its adoption by the Senate and House of Representatives as the standard in government publications of the United States of America.

It was ordered that the executive committee of the Naturalists be instructed to appropriate $200 to the Concilium Bibliographicum, Zurich.

A motion that the Naturalists schedule no program at its annual meeting for Thursday forenoon was referred to the executive committee.

There were elected to membership the following: G. A. Baitsell, Yale University; John Belling, Florida Agricultural Experiment Station; G. N. Collins, U. S. Department of Agriculture; W. J. Crozier, Bermuda Biological Station; B. M. Duggar, Missouri Botanical Garden; R. R. Gates, University of California; C. H. Heuser, Wistar Institute; Julian Huxley, Rice Institute; I. J. Kligler, American Museum of Natural History; H. H. Laughlin, Eugenics Record Office; Orren Lloyd-Jones, Iowa State College; L. B. Nice, University of Oklahoma; Oscar Riddle, Carnegie Station for Experimental Evolution; J. W. Scott, University of Wyoming; Gaylord Swindle, Fairview, Mo.; P. F. Swindle, Fairview, Mo.; J. E. Wodsedalek, University of Idaho; S. G. Wright, Bureau of Animal Industries.

By a vote of thanks the society expressed its hearty appreciation of the facilities and courtesies extended by the social committee and by the Ohio State University.

The program of the morning session was as follows:

F. M. Surface, "On the Inheritance of Certain Grain Characters in Oats." (Read by title.)

G. H. Shull, "The Inheritance of Acidia in *Fraxinus americana.*"

I. W. Bailey, "Botanical Evidence in Regard to Climate and Evolution."

A. F. Blakeslee, "Two Plants Adapted to Classwork in Genetics."

E. C. Jeffrey, "Hybridism and the Rate of Evolution in Angiosperms."

L. J. Cole, and W. H. Wright, "The Application of the Pure-line Concept to Bacteria."

Oscar Riddle (by invitation), "Sex Control and Known Correlations in Pigeons."

H. H. Love, "Variations in Daisies." (Read by title.)

C. B. Davenport, "Heredity of Stature."

A. M. Banta, "The Necessity of Sexual Reproduction in Certain *Cladocera.*"

C. C. Little, and E. E. Tyzzer, "Inheritance of

Immunity to a Transplantable Tumor of the Japanese Waltzing Mouse.''

The session of the afternoon consisted of a symposium on the subject ''Recent Advances in the Fundamental Problems of Genetics.''

H. H. Bartlett, ''The Status of the Mutation Theory with Especial Reference to the Genus *Œnothera*.''

W. L. Tower, ''Experimental Reproduction of Recurrent Mutations.''

E. M. East, ''The Significance of Selective Elimination of Gametes and Zygotes in Partially Sterile Hybrids.''

H. S. Jennings, ''Heredity, Variation and Selection in Uniparental Reproduction.''

C. B. Davenport, ''Inheritance of Human Traits.''

The Naturalists' dinner was held on the evening of December 30, at the Hotel Chittenden, with one hundred and fifty in attendance. Professor F. R. Lillie, as president of the Naturalists and vice-president of Section F, American Association for the Advancement of Science, read a paper on ''The History of the Fertilization Problem.''

The officers of the society for 1916 are:

President—Raymond Pearl, Maine Agricultural Experiment Station.

Vice-president—Albert F. Blakeslee, Carnegie Station for Experimental Evolution.

Secretary—Bradley M. Davis, University of Pennsylvania (1914–16).

Treasurer—J. Arthur Harris, Carnegie Station for Experimental Evolution (1915–17).

Additional Members of the Executive Committee—Edward M. East, Harvard University (1916); Henry V. Wilson, University of North Carolina (1915–17); Frank R. Lillie, University of Chicago (1916–18).

BRADLEY M. DAVIS,
Secretary for 1915

THE AMERICAN PSYCHOLOGICAL ASSOCIATION

THE twenty-fourth annual meeting of the American Psychological Association was held at the University of Chicago, December 28, 29 and 30, 1915. The sessions were very largely attended. The program listed more than seventy titles. Of these, twenty-two were studies in mental tests. Animal and educational psychology had eight titles each, while in the field of general experimental psychology there were thirteen papers. Of the remaining number, eight were of a theoretical nature. The address of the president, Professor John B. Watson, of Johns Hopkins University, was on ''The Place of the Conditioned-Reflex in Psychology.'' The speaker explained the method made famous by the Pawlow experiments as it has been adapted for experimentation upon human subjects in the Hopkins Laboratory, and discussed the possibilities of the method as a means of obtaining important psychological results. A special feature of the program was a discussion on ''The Relation of Psychology to Science, Philosophy and Pedagogy in the Academic Curriculum.'' The discussion dealt with the practical relations which psychology must, or should, assume towards the departments of instruction indicated. At the conclusion of the set papers a lively debate turned particularly upon the question of psychology's relation to the training of teachers. Professor C. H. Judd in his paper had contended that psychology is not a necessary prerequisite to the study of pedagogy.

On the day following the close of the meetings some forty members were the guests of Dr. William Healy. The party inspected the Detention Home of the Cook County Juvenile Court, lunched at Hull House, and, during the afternoon, sat with Judge Merritt W. Pinckney at a session of the Juvenile Court. On Monday, January 3, a joint session with Section VIII. (sub-section ''Sociological Medicine'') of the Pan-American Scientific Congress was held at the Raleigh Hotel, Washington, D. C.

As officers for the current year, Professor Raymond Dodge, of Wesleyan University, was elected president, while Professors H. A. Carr, of the University of Chicago, and Knight Dunlap, of the Johns Hopkins University, were selected to succeed Professors J. W. Baird and Madison Bentley on the council. An invitation extended by the department of psychology to hold the next annual meeting at Columbia University was accepted. The meeting will occur during ''Convocation Week'' in affiliation with the American Association for the Advancement of Science. A resolution introduced by a number of past-presidents of the association was voted, which provides for some special observance of this, the twenty-fifth annual meeting of the association.

The tentative plan of conducting election to office in the association which has been in operation for the past three years, will be continued with certain modifications. Hereafter the committee having this matter in charge will function

as an election committee, and will communicate with all members of the association, first, to secure a primary ballot of nominations, and again to secure a ballot of election; votes being taken from a list of candidates receiving the highest number of ballots in the primary. In its modified form this method of election is now before the association as a constitutional amendment.

A resolution was passed to the effect that the association "discourage the use of mental tests for practical psychological diagnosis by individuals psychologically unqualified for this work." By resolution, also, the retiring president was authorized to appoint a committee for the purpose of expressing approval of plans for the establishment of a station for the study of the behavior of primates. The committee, as appointed, consists of Professor J. R. Angell, University of Chicago, chairman; Professor Raymond Dodge, Wesleyan University; President G. Stanley Hall, Clark University; Professor G. M. Stratton, University of California, and Professor E. L. Thorndike, Teachers College, Columbia University.

R. M. Ogden,
Secretary

THE BOTANICAL SOCIETY OF AMERICA. III

Fiber Measurement Studies: A Comparison of Tracheid Dimensions in Longleaf Pine and Douglas Fir, with Data on the Strength and Length, Mean Diameter and Thickness of Wall of the Tracheids: Eloise Gerry.

This paper is a progress report on the fiber dimension studies that are being made as a part of the investigation into the mechanical, physical and chemical properties of Longleaf pine, *Pinus palustris* and Douglas fir, *Pseudotsuga taxifolia* at the U. S. Department of Agriculture, Forest Products Laboratory, which is maintained in cooperation with the University of Wisconsin at Madison, Wisconsin. The microscopic investigations were made at every tenth annual ring on large cross section from old trees. The following data were recorded for each ring: Age, width, per cent. of summer-wood, height above the ground, distance from the pith, and resin content. Fifty measurements were made of the length, mean diameter and thickness of wall to obtain average. The spring and summer-wood were recorded separately. A number of tracheids proportional, respectively, to the per cents. of spring and summer-wood in the ring were measured. This data supplements that previously presented. It includes a summary of over 7,000 measurements on Douglas fir and 5,000 on longleaf pine. The results are as follows: (1) No evidence could be found for a constant fiber length such as was reported by Sanio for the Scots pine. (2) There are many more bordered pits in the spring than in the summer-wood tracheids. The ends of the tracheids may frequently be blunt or forked. They are generally very pointed in the summer-wood. (3) The summer-wood tracheids in any ring are, in general, shorter than the spring-wood tracheids in all the material studied. (4) There is a rapid increase in all dimensions during the first twenty years. (5) The variation in length in a single tree was found in one disk to be .80–7.65 mm. (6) A direct relation appears to exist in the Douglas fir studied between the thickness of the cell walls of the summer-wood and the strength of the material. The thickness of wall and strength of material were both low in young material. (7) No marked relation was found between width of ring and fiber dimensions. A tendency was noted for the young wide-ringed material to have relatively short, narrow tracheids with thin walls. (8) In studying a 455-year-old Douglas fir the possibility was considered of finding indications of old age or decline indicated in the size of the elements. No such effect was discovered. (9) The Douglas fir and pine did not vary widely in the dimensions of their elements. The thickness of wall averaged high in the longleaf pine, but the diameters were somewhat less than those in fir.

Xerofotic Movements in Leaves: Frank C. Gates.

Xerofotic movements are paratonic movements, caused by unequal drying effects in direct sunlight, manifested by an upward bend in the leaflets, or the curling upward of the blade. The upward movement is produced by differential turgidity in certain cells. The greater turgidity of the cells on the lower, less exposed side causes the organ to move upwards. In the *localized* xerofotic response, the differential turgidity is largely confined to a small region, for example, the pulvini of leguminous leaflets. In the *generalized* response, the blade of the leaf curls or rolls upwards. The monocot families, Poaceae, Araceae, Marantaceae and Zingiberaceae furnish examples of the generalized response. The Leguminosae furnish the best examples of the localized response, with which this paper deals. Whether the night position of the leaflets is erect or drooping, the xerofotic response is between 45° and 70° above the horizontal or normal day position.

Variations of exposure result in variations of response, even in leaflets of a pair. The xerofotic position decreases the amount of direct radiant energy received per unit area of leaf, reducing the harmful action of too intense sunlight on the chlorophyll, as well as checking the transpiration. Experimental work with screens upon *Gliricidia sepium, Leucaena glauca, Mimosa pudica* and *Ipomoea pes-caprae* limited the causation of the xerofotic response to the action of direct sunlight. The application of chemical drying agents (absolute alcohol and xylol) to the upper side of the large pulvini of *Gliricidia sepium* and to the upper side of the midrib of the clam-shaped leaves of the strand plant, *Ipomoea pes-caprae,* resulted in the assumption of the xerofotic position.

The Osmotic Value of Sea Water and the Osmotic Surplus of Several Marine Algae: R. H. TRUE.

The osmotic value of sea water was determined by the plasmolytic method, *Spirogyra* calibrated by means of NaCl and cane sugar solutions being used as an osmometer. The value so obtained was compared with the values obtained by the freezing-point method and found to agree fairly closely. The osmotic value of several marine algae was also determined and the osmotic surplus was shown to be of the same order of magnitude as that seen in higher land plants.

Measurement of the Surface Forces in Soils: CHARLES A. SHULL.

The internal forces causing absorption of water by dry *Xanthium* seeds have been measured and found to have an initial value of at least nine hundred and sixty-five atmospheres. The internal forces have been determined at various contents covering the range between air-dry and saturation. Dry seeds have been used to measure the surface-holding power of soils for water, with the result that air-dry soils hold water with approximately the same force as an air-dry seed (900–1,000 atms.). As the capillary moisture increases the surface force decreases, until, at the wilting coefficient of the soil, the amount of "back pull" exerted is not more than three or four atmospheres. This relation holds essentially for all types of soil from heavy clay to sand. The soil, therefore, at the critical moisture content for the plant, holds the water with less force than the osmotic pressure of the root hairs of plants, as determined by plasmolytic methods. The wilting of the plant at the wilting coefficient does not result from lack of moisture, or lack of a gradient toward the plant, but probably from the low rate of movement of water as the friction of movement in thin films increases.

The Interrelation of Transpiration, Root Absorption and Water-absorbing Capacity of Tissues in an Opuntia: EDITH B. SHREVE.

Previous workers have found that the transpiring power (*i. e.,* the absolute transpiration rate divided by the evaporative power of the air for the same period) is greater in cacti for the night than for the day. The following is a general summary of the results of an investigation into the causes of this phenomenon. (1) The transpiring power is greatly influenced by light intensity, air temperature, water-content of tissues and available soil water; and these factors very clearly exert their influence indirectly through their action on some other internal process. (2) The day-to-night variations in transpiring power are independent of any day-to-night variations in root absorption. (3) During the daylight hours more water is absorbed by the roots than is lost by transpiration, while at night the reverse is true. (4) Variations in water-intake by the roots are due, on the one hand, to variations in soil retentivity and, on the other, to variations of conditions within the plant itself, and the latter may be subdivided into variations in the absolute transpiration rate and in the water-absorbing power of the tissues. The variations in soil retentivity may be reduced to zero by the use of water cultures and of supersaturated soils. Then on dividing the absolute rate of water-intake at the roots by the absolute transpiration rate for the same period, a quantity is obtained which must represent that part of the root absorption which is independent of variations in transpiration as well as in the retentivity of the soil. This quantity (A/T) has been termed the secondary absorbing power of the roots. Its variations are independent of transpiration, and furthermore, it varies inversely with transpiring power. That is, A/T is greater for the day than for the night and T/E is greater for the night than for the day. (6) Stomata are, in general, shut during the day and open at night, but it is not possible to ascertain whether the closing of the stomata accompanies or follows a decrease in transpiration rate. (7) The water-absorbing capacity of cylinders cut from the internal tissue is less at night than during the day, being least from 4 to 5 A.M. and greatest from 3 to 5 P.M. This is true whether the calculations are based on dry weight or on original wet weight. (8) The theory is advanced that the water-absorbing ca-

pacity of the internal tissue controls the secondary absorbing power of the roots and probably also the transpiring power, since a greater absorbing capacity would mean also a greater resistance capacity to the loss of water. It seems quite possible that in the forenoon the increasing absorbing capacity of the internal tissues may take water from the guard cells, thus causing them to close, and at night the decreasing water-holding capacity may allow the guard cells to take water from the internal tissues, and thus open. The effects exerted by light intensity and air temperature, together with their duration, show that the variations in absorbing capacity are due, at least in part, to chemical changes brought about by the metabolic processes. Many tests showed that the changes in the water-absorbing capacity of the tissues parallel acidity changes in the plants in such a way that when the acidity is highest the absorbing capacity is lowest, and *vice versa*. However, certain exceptions which occur under controlled conditions show that the relation can not be so simple as the influence of mere changes of H-ion concentration. Consequently other factors must be taken into consideration, including the accumulation and disappearance of the salts of organic acids. It is impossible to state yet whether the absorbing capacity of the internal tissue is due to colloidal absorption or to osmotic forces or to both. Although the concentration changes in the total sap which are indicated by the known changes caused by the metabolic changes and by the changes in water-content seem to show that osmotic forces are not of prime importance in controlling the water-absorbing capacity of tissues, still there is no direct proof that it is colloidal absorption which is the sole or the controlling force.

Physiological Temperature Indices for the Study of Plant Growth in Relation to Climate: Burton E. Livingston.

The aim of this study is to obtain indices of temperature efficiency for plant growth, by means of which temperatures on the thermometer scale may be weighted in evaluating the temperature term of the environmental complex in physiological, agricultural, forestal and ecological investigation. The system of indices here brought forward is based on the results of Lehenbauer's recent study of the relation of temperature to growth of young maize shoots exposed twelve hours to maintained temperature. Lehenbauer's graph is first smoothed mechanically, and then the ordinates for each degree of temperature are measured. These are all expressed in terms of the ordinate for 40° F. (4.5° C.) taken as unity. The index values increase from zero (2° C.) through unity (4.5° C.) to 122 (32° C.), and then decrease again to zero (48° C.). This is the first system of temperature efficiency indices that takes account of the optimum and maximum in the growth-temperature graph. A chart of the climatic zonation of the United States with respect to temperature efficiency for plant growth during the period of the average frostless season is shown, based on the new indices.

A Single Climatic Index to Represent Both Moisture and Temperature Conditions as Related to Plants: Burton E. Livingston.

A method is described by which the indices of precipitation, of atmospheric evaporating power, and of temperature efficiency for plant growth, for any period of time, may be combined into a single index of moisture-temperature efficiency. The new index is the product of the rainfall-evaporation ratio and the summation index of temperature efficiency for the period. The method is only a first approximation and improvements are of course to be expected. By means of these moisture-temperature indices a new climatic chart of the United States is constructed, for the period of the average frostless season. This chart shows that, as far as moisture and temperature conditions are concerned, peninsular Florida possesses the best climate for plant growth, while the least efficient climates of the country are those of the extreme north and of the arid regions. The natural climate of the arid regions is modified by irrigation, and that of the cold regions is modified, on a small scale, by artificially heated greenhouses.

A Living Climatological Instrument: B. E. Livingston and F. T. McLean.

While methods for interpreting instrumental records of climatological conditions are being devised, climates may be studied and compared in terms of their actual effectiveness in promoting growth of standard plants. In the first trial of this method the plants were grown in plunged pots, always filled with the same kind of soil, which was renewed after each culture. Ten different stations in Maryland were employed. Soy bean proved very satisfactory as a standard plant. Seeds were soaked in water at a given temperature for a certain time before planting. Various measurements were made on the plants after two weeks and

again after four weeks, when cultures were discontinued. New cultures were started every two weeks. The plant here is regarded as a self-integrating instrument set at zero of its scale at beginning of each four-week exposure period, and the integrations of climatic efficiency for plant growth are read in terms of plant measurements after two and after four weeks, when the instruments are again set at zero. The value of the climate for any two-week or four-week period at any station may be compared with that for any other period, either at the same or at another station.

The Daily March of Transpiring Power as Indicated by the Porometer and by Standardized Hygrometric Paper: SAM F. TRELEASE AND BURTON E. LIVINGSTON.

The transpiring power was determined for the lower surfaces of *Zebrina* leaves at intervals throughout day and night, by method of standardized cobalt chloride paper. At the same intervals porometer readings were made. If porometer rates are proportional to average cross-sectional area of stomatal pores, then stomatal diffusive capacity (Brown and Escombe) should be proportional to square root of porometer rate at any time. Graphs of this diffusive capacity and of transpiring power were made for the same periods. Both graphs agree in showing the same kind of daily march; values of both indices rise to maximum in day and fall to minimum in night. But the range of variation between minimum and maximum values is generally somewhat greater for indices of diffusive capacity. It appears that porometer rates do furnish data for deriving stomatal diffusive capacity in this case, but that this capacity is not quite proportional to transpiring power; transpiring power is here mainly dependent upon degree of stomatal opening, but other conditions are influential. If the index of transpiring power for each determination be divided by the corresponding square root of the porometer rate, a value is obtained that appears to be approximately proportional to the non-stomatal influence upon transpiring power.

The Transpiring Power of Plants as Influenced by Differences of Altitude and Habitat: FORREST SHREVE.

Measurements of the transpiring power of the leaves of some twenty species of plants were made in the Desert and Encinal regions of the Santa Catalina Mountains in southern Arizona in the arid foresummer of 1915. The method of standardized hygrometric paper was used on the plants in their natural habitats. The species investigated belonged to various life-forms. They differed both in the values of their transpiring power and in the character of its daily changes. The same species exhibits a higher transpiring power in the individuals which grow in flood plains than in those which grow on arid slopes. The daily changes in the former individuals are concordant with the daily march of evaporation; while in the latter case the transpiring power falls sharply before the daily maximum of evaporation is reached. A comparison of the transpiring power of the same species at different elevations has shown that the daily check is applied earlier in the day at lower elevations and later at higher ones. The check is manifested, for example, in Emory oak at 5,000 feet, but is in abeyance at 6,000 feet, where the maximum transpiring power and maximum evaporation are simultaneous. In the mesquite the check is applied earlier on the desert at 2,500 feet, later at 4,200 feet and at 5,000 feet, but is not eliminated at the upper limit of the species at the last-named elevation. The values for the transpiring power are in all cases higher at lower elevations, but at the higher elevations the values, although not so high, are sustained through a longer portion of the day.

Cultures of Uredineae in 1915: J. C. ARTHUR.

The report upon rust cultures for the season of 1915 makes the fourteenth covering consecutive work, which was begun in 1899. An interesting observation on the production of the alternate stage of rye rust upon *Anchusa* is given. Aecia of *Puccinia Seymouriana* on *Spartina,* heretofore only known upon *Cephalanthus,* were grown upon hosts representing two additional families. Another species of *Puccinia* on *Spartina* of limited distribution in the northwest is shown to be the correlated form of *Uromyces Spartinae,* and from the southwest a species of *Uromyces* on wild *Hordeum* is conversely found to be the correlated form of the common barley rust, *Puccinia Hordei,* thus adding further proof of the essential identity of the genera *Uromyces* and *Puccinia. Puccinia Eriophori* Thüm., in both its aecial and its telial forms, is established as a widespread American species. Altogether about twenty successful cultures were obtained, supplying various items of information, partly confirmatory and partly new.

The Injurious Effect of Tarvia Fumes on Vegetation: A. H. CHIVERS.

An account is given of the destruction of a gar-

den at Hanover, New Hampshire, by fumes of a tar compound known as tarvia which was melted at a time when atmospheric conditions were such as to cause the fumes to hug the ground and blow over the near-by garden, with the result that at least twenty species were killed or severely injured. The rapid and characteristic action of the fumes seemed to favor certain conclusions. A brief review of literature regarding smoke and fumes is given, together with a brief description of a series of experiments which indicate that the following is true regarding the nature of the injury. (1) The injury was due to the constituents of the volatile substances which condensed in the form of an oily coating on the surfaces of the plants. (2) The injury did not involve, to any extent at least, the passage of gases through stomata. (3) The injury was due to the action of the fumes on aerial parts. (4) The injury varied with the distance from the escaping fumes, the temperature of the melting tar, and the age of the plant structures.

A Canker of Apple Caused by Plenodomus fuscomaculans: G. H. Coons.

A serious canker of apple has been found in some orchards in northern Michigan. This canker is characterized by the elongated lesions which are commonly accompanied by checking of the bark into small squares or rectangles. Lesions are found extending along the limb, commonly on the under side. These are the result of the killing of the bark in strips. In the older cankers the killed bark drops off, leaving the bare wood. One limb may show all stages of the trouble, from freshly killed bark to the decorticated wood. In the bark and especially on the bare wood pycnidia are found in abundance. The wooly aphid by its attack makes the canker very unsightly and greatly interferes with the natural healing of the wound. The causal relation of an associated organism, *Aposphaeria fuscomaculans* Sacc. has been shown by the ordinary rules of proof. Recent work on the genera of the Sphaeropsidales has given cause for rearrangement in the old genera. From a study of the morphology of the organism associated with this canker, it has seemed advisable to transfer the fungus to the genus *Plenodomus*. The physiological relations of the causal organism has been studied at considerable length, but an account of these is being published separately in the *Journal of Agricultural Research*. The results may be summarized by stating that this organism shows relations to environmental factors, quite as sharp as those reported by Klebs for *Saprolegnia* and other fungi. In particular light was found essential for pycnidium formations. Successful inoculations were obtained on the limbs of Wealthy, Duchess, Jonathan and Ben Davis apple as well as upon the Hyslop crab. Other standard varieties seem more resistant, especially the Northern Spy. The fungus has been successfully inoculated into pear, small cankers being formed. No successful inoculations could be obtained on apple leaves. Apple fruits of various kinds are only very slightly invaded by the fungus, no conspicuous rotting or spotting being caused. The fungus shows marked attenuation after being grown in culture. The disease has been successfully controlled by methods commonly advised for apple canker.

Recent Contributions to our Knowledge of the Genus Gymnosporangium: Frank D. Kern.

A little more than four years ago the writer published an account of the genus *Gymnosporangium*, "A Biologic and Taxonomic Study of the genus *Gymnosporangium*," which purported, as the title indicated, to cover all of the information available at that time relative to the biology and taxonomy of these plants. Since that time there have appeared more than a dozen papers which have contributed additional facts to our knowledge of this interesting genus. These contributions have been of varied interest, some concerning life-histories, others relating to anatomy, physiology, taxonomy, distribution or pathologic importance. The scattered condition of the additional information, as well as the accumulation in the writer's hands of unpublished data, has suggested the idea of bringing together in one account the more important facts. The appended bibliography, in connection with the one formerly given, will serve to direct any one to the original sources provided exceptions may be taken to any interpretations here given. With the exception of a broad general statement it seems most satisfactory to make an arrangement of notes under specific headings since, for the most part, references deal with individual species rather than the genus as a whole. Among the more notable points brought out in the various special papers may be mentioned the report of another aecial host outside the Rosales, the finding of teliospores in the species possessing uredinia, studies upon the effects produced by the hosts upon the morphology of the fungi, and active investigations of the species causing diseases of economic importance.

The Relation of the Seed Stock to the Control of Bean Anthracnose and Bean Blight: J. H. MUNCIE.

On account of the enormous losses caused by them, the diseases, anthracnose and blight, have become a serious menace to the bean-growing industry of the United States. For the season of 1915 it is estimated that the loss, to the Michigan bean crop alone, is at least a million bushels and the money loss about two and one half million dollars. The control measures, recommended by various authors, incorporated with our own, have been tried out in our experimental plats. These measures consist of the application of fungicides to the growing plants and treatment of the seed with chemical solutions and hot water. In no case did these measures prove satisfactory in controlling the diseases. Likewise the planting of native seed from some of the western states proved unsatisfactory. It has been found possible to grow Michigan seed beans in western states where the climate is favorable and where these diseases are of no economic importance, and to secure, in this way, seed apparently free from disease. The behavior of the plants from western-grown Michigan seed will be further tested in our experimental plats. Since spraying and seed treatments have failed to control these diseases, we have sought for a palliative, to be employed until some satisfactory control measure can be worked out. We have found that by planting a variety of beans of high productivity, the losses due to these diseases can be so decreased that, in ordinary years, they will not be burdensome to the industry. This variety of pea beans is known commercially in Michigan as the Early Wonder. According to Mr. W. W. Tracy, of the U. S. Department of Agriculture, this variety was heard of in western New York, in 1890, as the Little Early Scofield. Seed from a single plant was first grown in Michigan in about 1908. Later, when seed from this variety was put on the market the varietal name was changed to Early Wonder. Early Wonder beans have been observed under field conditions in six of the principal bean-growing counties of this state, during the past three seasons. At least two thousand acres of beans of this variety were under observation this season. This variety of beans is well adapted to Michigan conditions, matures early and produces well. On account of this early ripening, the pods harden before the diseases have made serious inroads into the tissue, thus preventing to a great extent the spotting of the seed. Data collected for the past three seasons bring out the following points: (1) Early Wonder beans ripen from ten days to two weeks earlier than ordinary home-grown varieties. (2) The average yield per acre is twenty bushels. (3) The average pick per bushel is two pounds. (4) The seed is uniform in size, shape and color. (5) The pods ripen evenly and hang high above the ground. (6) Early Wonder beans produce well, even under severe disease and weather conditions. We are recommending that true Early Wonder beans be planted in Michigan as a palliative measure until some more successful control measure for the anthracnose and blight can be found.

New Methods and Apparatus for Determining, Qualitatively and Quantitatively, the Effects of Sulphur Dioxide on Plants: P. J. O'GARA.

A résumé of the work done by European and American workers is given. It is shown that the methods of sulphur dioxide analyses have been in error, this error often reaching up to one thousand per cent. or more. Furthermore, the type of apparatus used in subjecting plants to an atmosphere containing sulphur dioxide gas was faulty. In addition it may be stated that the effects of the various environmental factors, such as temperature, humidity and light, were not sufficiently taken into consideration as affecting plants subjected to an atmosphere containing sulphur dioxide. The methods employed in the experimental work which has been carried on by the writer and his assistants have been such as to take into account every factor which would influence the effects of sulphur dioxide on plants. For the first time it has been possible to measure accurately extremely minute quantities of sulphur dioxide. It has been possible to subject plants to known concentrations of sulphur dioxide and to check these concentrations during the progress of the experiments. During the seasons of 1914 and 1915 twenty-six agricultural crops were investigated, the purpose being to determine qualitatively and quantitatively the effects of sulphur dioxide when employed at various concentrations and at the various periods of growth of the various crops. During the two years during which the experimental work has been carried on fully two thousand experimental plots have been used. The new methods and appliances will be shown by the use of a large number of lantern slides.

Concerning Certain Peculiar Tissue-strands in a Protomyces Gall on Ambrosia Trifida: ALBAN STEWART.

The stems of the great rag-weed, *Ambrosia trifida,* are sometimes infected by *Protomyces*

andinus Lagh. causing the formation of large galls. These usually occur just above the ground, but it is often the case that they may also occur higher up on the stem, as much as two feet above the galls, which are located near the roots. Both kinds of galls have essentially the same histological structure. In the deeper portions of the galls, near the pith where infection evidently starts, peculiar tissue-strands are formed which are similar in some respects to the tumor strands which have been found in the stems of certain plants infected with the crown-gall organism, *Pseudomonas tumefaciens*. The strands consist of whorl-like arrangements of thin-walled cambiform cells which usually enclose groups of sporanges of the fungus. Short tracheids sometimes accompany the strands. The strands may occur singly or in groups, and usually run in a vertical direction. They have been found both in the galls located near the ground and in those higher up on the stem, but there is no indication of them in the normal part of the stem between two such galls. They are purely local and have no relation one gall with another. The fact that abnormalities in the tissues of the host plant are to be found in or nearly to the pith in the infected parts, indicates that the stems become infected while they are still quite young, probably before secondary thickening starts. This offers a possible explanation as to how the upper galls on the stems come about. In the young seedling plant there are a number of short internodes formed near the ground which lengthen out by subsequent growth. If the lower internodes should become infected at this time the infected parts would probably be carried up later by the lengthening of the stem.

Anthracnose (Colletotrichum lagenarium (Pass.) E. and H.) a Serious Disease of Cucurbits (preliminary report): J. J. Taubenhaus.

Watermelons, cantaloups and cucumbers are important crops in the trucking districts of Delaware. Of late growers are experiencing great difficulty in raising these cucurbits, especially watermelons. Conditions are similar in neighboring states of New Jersey, Maryland and Virginia. Investigations on cucurbit diseases undertaken at Delaware have shown that the difficulties mentioned are occasioned by several diseases. One of the chief causes of failure of watermelons in Delaware and vicinity is the anthracnose disease. The latter causes a deep spotting on the rind of the fruit impairing its shipping quality. The disease, too, is the cause of a serious leaf spot, and a blight and canker of the vines. The attacks are severest on the watermelon crop in its second successive year. For this reason growers are forced to practise a rotation of six years or longer. *Colletotrichum lagenarium* also causes a serious leaf and fruit disease of cucumbers and citrons, the latter of which are usually considered the most immune of all cucurbit plants. It also attacks the fruits of cantaloups and the ornamental gourd. Pumpkins and squashes seem to be free from the attacks of the fungus. Cultures of *Colletotrichum lagenarium* from all the cucurbitaceous hosts mentioned are very easy to obtain. Cross inoculations with pure cultures have shown that the anthracnose from watermelons, cantaloups, cucumbers, citrons and ornamental gourd are all one and the same; the disease may be readily transferred from one to the other. Investigations are now under way to determine the life history of *Colletotrichum lagenarium*, its relationship to the various hosts and to other species of Colletotrichums, especially *C. lindemuthianum*, and methods of control. Besides anthracnose there are two other apparently new diseases of the watermelon which are being investigated.

Fungi producing the Heart-rot of the Apple: B. O. Dodge.

Polyporus admirabilis Peck was found on many living apple trees at Litchfield, Conn., during the month of August. The fruit bodies were growing singly or in clusters. Individual sporophores vary in size from ten to forty centimeters in diameter. The heart-wood is first attacked and the fungus gradually encroaches on the sap-wood until the limbs and trunk are weakened to such an extent that they are broken down during wind-storms. Apple trees of the east are more commonly attacked by another type of polypore. These are the white bracket forms frequently found on the inside of hollow trees near knotholes. When growing on the outside of a tree the mycelium penetrates the sap-wood up and down for some distance so that the base of the trunk may bear a large number of imbricated sporophores. This type of fungus belongs to the *Spongipellis* group. *Polyporus galactinus*, or *Polyporus spumeus* var. *malicola* is the species found in the old apple orchards of the New England states. The form attacking the apple tree in Virginia, identified as *Polyporus fissilis*, is very near to *P. galactinus*, but it has larger pores and thicker flesh.

H. H. Bartlett,
Secretary